FLATROCK-HAW CREEK WATERSHED MANAGEMENT PLAN

Vision Statement: *Flatrock-Haw Creek Watershed: A pristine environment for the future*

Mission Statement: The Flatrock-Haw Creek Watershed Project will seek to promote stewardship of the natural resources in the watershed and conserve its agricultural heritage, while ensuring the sustainability of the area.

Friday, April 15, 2011

Table of Contents

Figures

Tables

1.0 Introduction

1.1 Brief History and Overview

The Flatrock-Haw Creek Watershed 10 digit Hydrologic Unit Code 0512020506 (HUC) encompasses approximately 131 square miles (83,868 acres) in the 8 digit HUC Flatrock-Haw Creek Basin 05120205 (Figure 1.1). The majority of the watershed acreage lies in Bartholomew County with a portion of the area lying in Shelby County (Table 1.1).

Figure 1.1 10 digit HUC Flatrock-Haw Creek Watershed in relation to 8 digit HUC Flatrock-Haw Basin

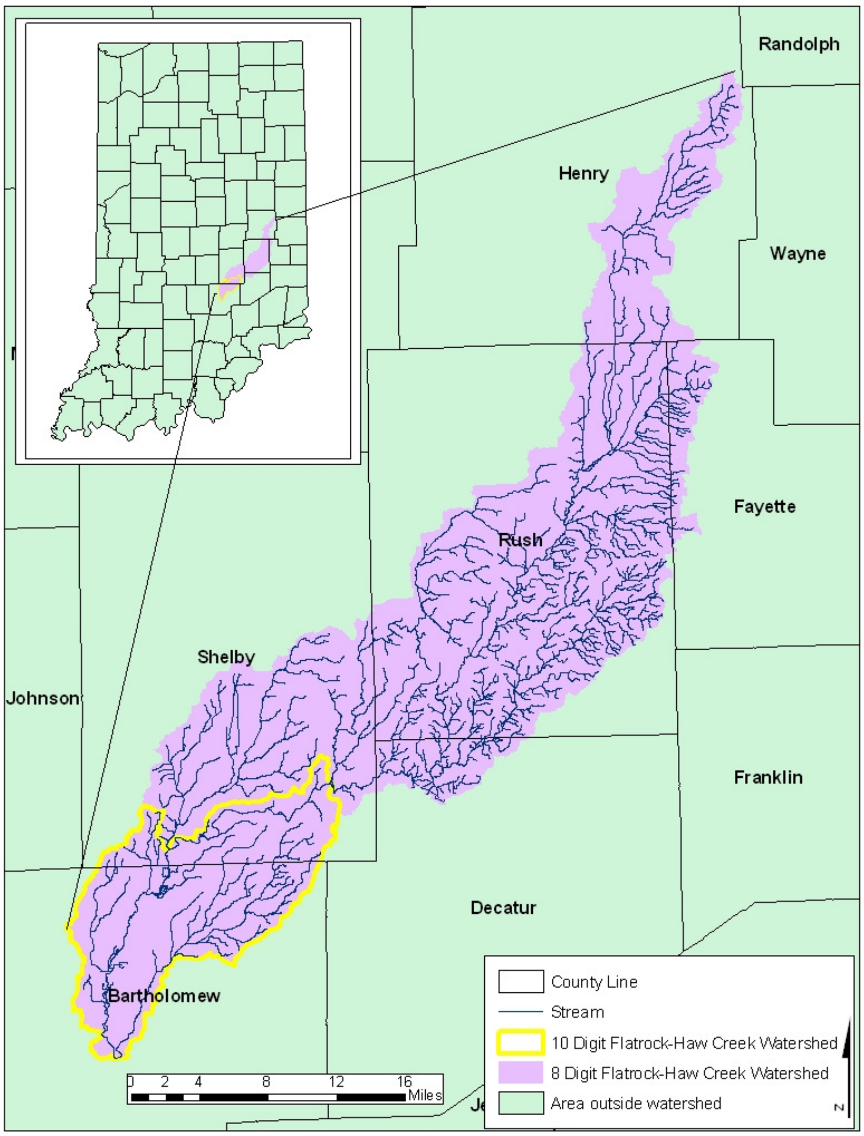


Table 1.1 Watershed areas relative to county boundaries

County	Percentage of Watershed	Approximate acres in Watershed	Percent of County
Bartholomew	75%	62,901	24%
Shelby	25%	20,967	8%

The land use in the watershed is mostly agricultural (78%), with predominantly a corn and soybean rotation with a few pasture operations. Livestock farms vary in size throughout the watershed from small family farm operations to larger confined feeding operations. Developed areas with the majority being low to high intensity make up a portion of the watershed and are the next largest percentage of land use type in the watershed. The city of Columbus is almost entirely contained within this watershed and is the largest urban area in the watershed. (Pop. 39,609)

The mission of the Bartholomew County Soil and Water Conservation District (BCSWCD) is to provide quality assistance and education to help empower Bartholomew County residents to protect and preserve their natural resources. With the Flatrock-Haw Creek Watershed adjacent to the Clifty Creek Watershed, the BCSWCD hopes to expand on the area residents' knowledge, continue to build partners in the area, and continue to improve their county natural resources.

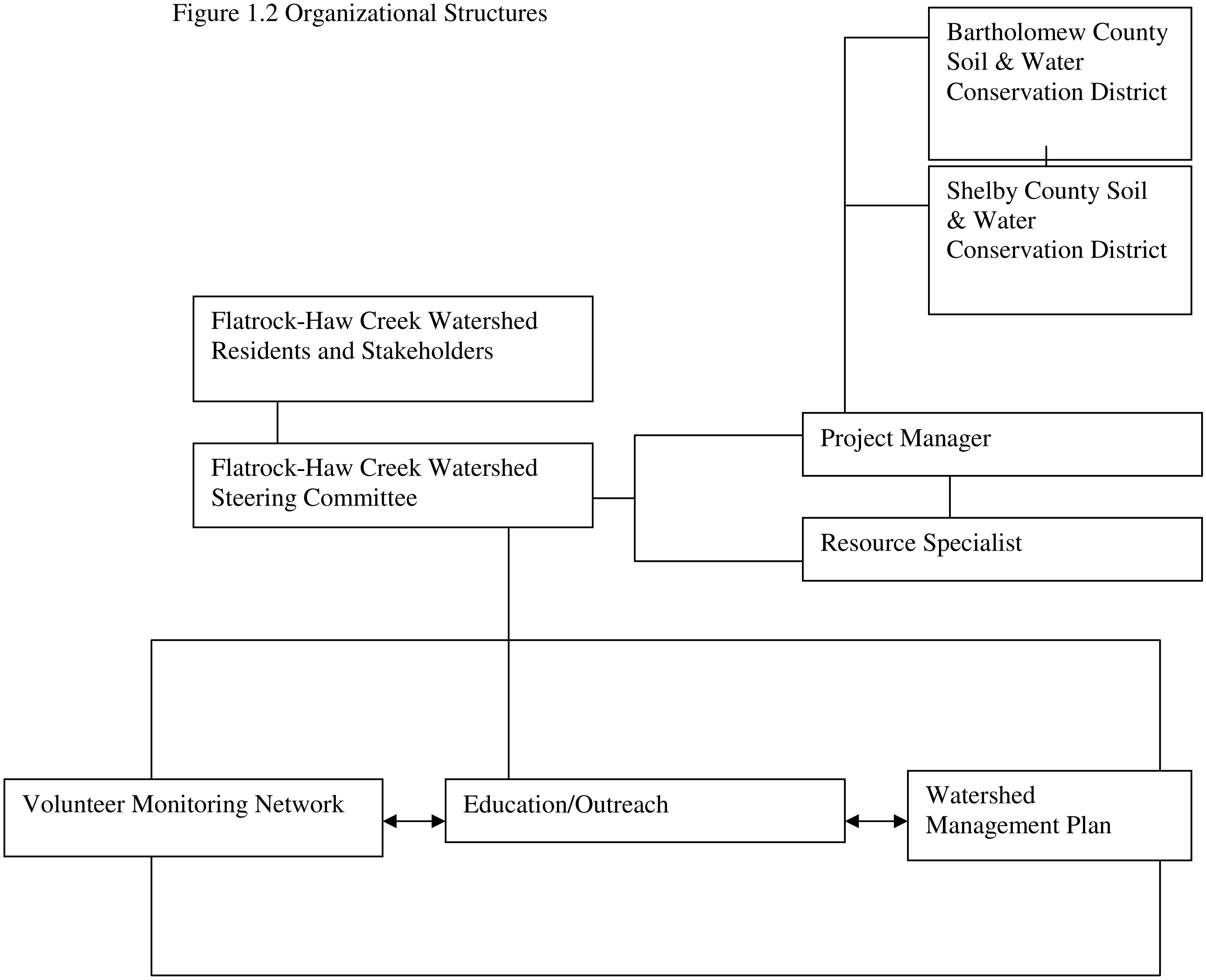
Additionally, the Indiana Department of Environmental Management (IDEM) determined that several segments (refer to Section 4.1) of the water bodies within the watershed did not meet recreational standards for E. coli (235 colony forming units (cfu)/100 mL). In turn, IDEM developed a Total Maximum Daily Load (TMDL) in August 2005 for the larger Flatrock-Haw Creek Basin for E. coli. That TMDL includes five (5) sample sites that fall within the smaller Flatrock-Haw Creek watershed boundary.

Based on data available, BCSWCD approached Shelby County SWCD (SCSWCD) for support in application of a planning phase of a IDEM Section 319 grant. Funds were awarded to the BCSWCD in April 2008 to address the nonpoint source pollution issues in the Flatrock-Haw Creek Watershed.

1.2 Building Partnerships

In order to best meet the needs and interests of the county, BCSWCD and the State agreed that project decisions and the direction of the watershed planning should be made by a representative local steering committee that is specific to the watershed project (Appendix A). Additionally, BCSWCD decided to contract two full-time positions to coordinate the details of this project and facilitate its progress, as well as to continue implementation work in the Clifty Creek Watershed (Figure 1.2). The project was introduced to residents through newspaper advertising, personal invitations, radio announcements, and a large scale public kickoff meeting. At the meeting an initial watershed survey (Appendix B) was passed out in addition to concern cards where residents could rank the resource concerns listed as they saw fit (Appendix C). The kickoff meeting hosted thirty five (35) individuals representing Bartholomew and Shelby County. The purpose of the meeting was to introduce the project and seek interest from residents and landowners to form a locally led steering committee.

Figure 1.2 Organizational Structures



Response to the public meeting and personal invitations was noted, with eight individuals in attendance at the first steering committee meeting. Initial concerns were identified and discussion of the group's vision, mission statements, as well as the project logo occurred. Some of the initial concerns included a lack of education about water quality issues, stream cleanliness (sediment, nutrients, E.coli), and trash along the stream banks.
(More discussion of these concerns can be found in Section 5.1.)

2.0 Watershed Description

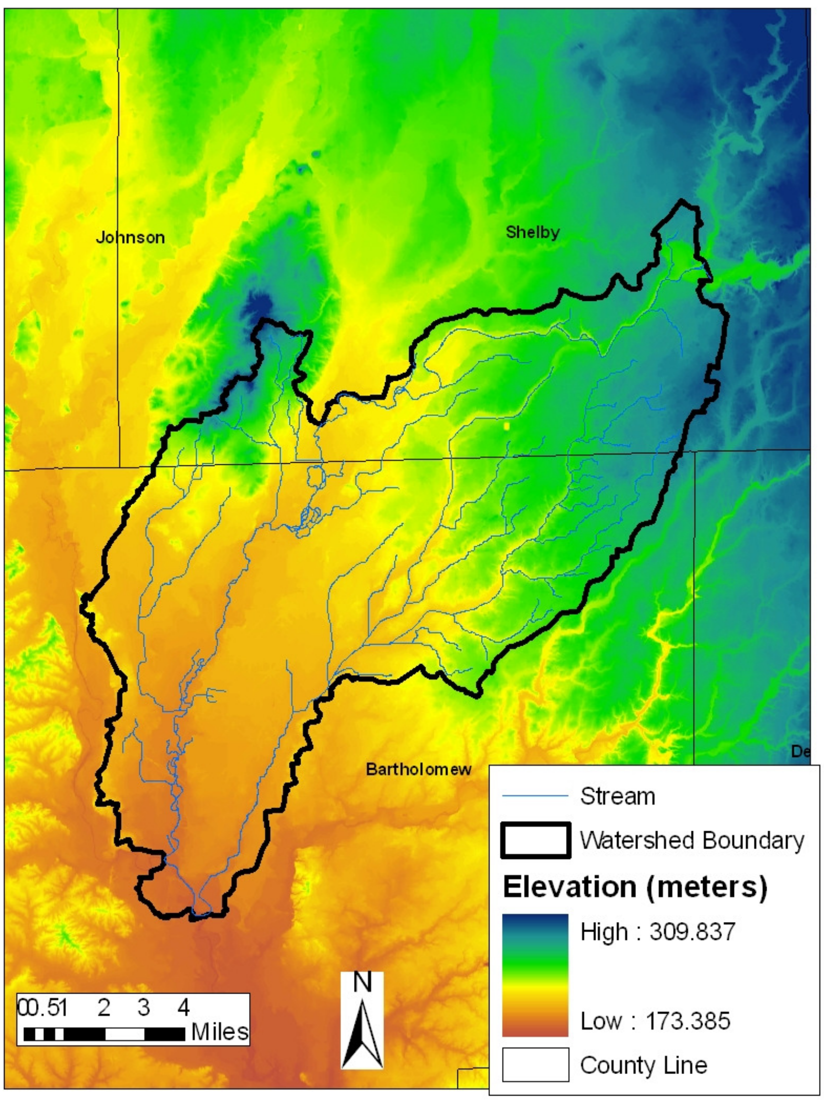
This section includes maps displaying topography, hydrology, legal drains, physiography, geology, leaching potential, soils, native vegetation, wetlands, and forestland of Flatrock-Haw Creek Watershed. Also included is information about the natural features and endangered species that could occur in the watershed.

2.1 Topography

Topography is the surface configuration of an area and one of five soil forming factors. Areas with more rolling topography can have increased erosion and runoff. Steeper slopes increase the flow velocity of runoff, leading to erosion. In addition to the sediment that is removed in erosion, the highest concentration of nutrients is contained in that upper layer of soil. The additional sediments and nutrients can have adverse effects on water quality. Increased sediment can smother in-stream habitat and clog gills of aquatic inhabitants. Sediment also increases water temperature and decreases dissolved oxygen content.

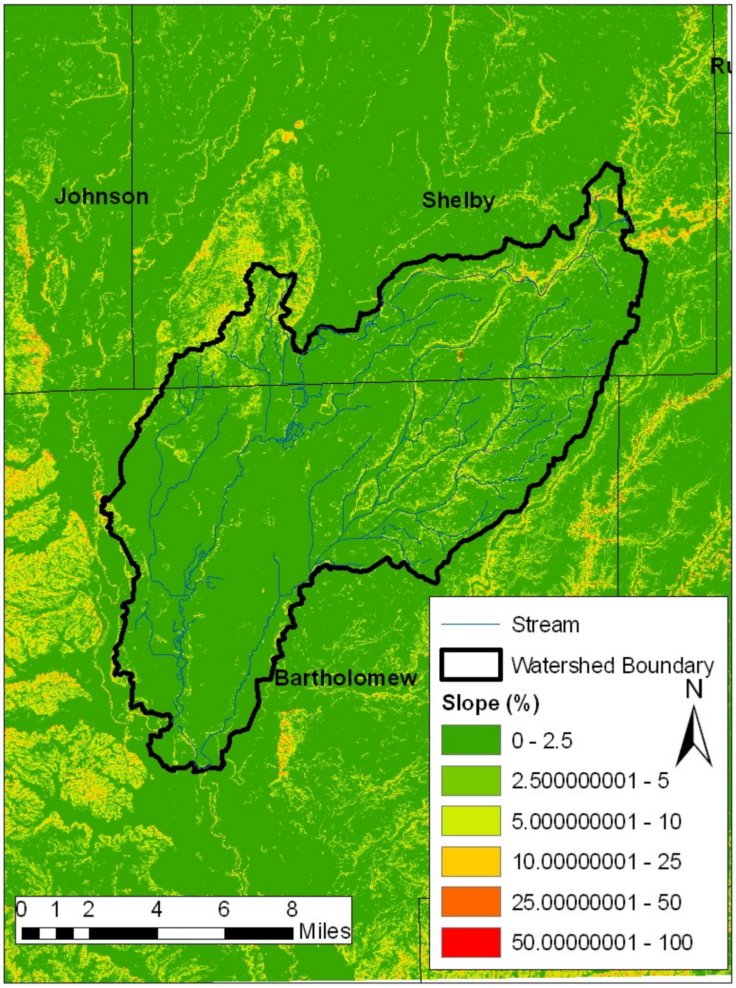
From the upper reaches of Flatrock-Haw Creek Watershed in Shelby County to where it drains into the East Fork of the White River, just south of Columbus, the elevation drops 90 meters (approximately 295 feet) (Figure 2.1-1).

Figure 2.1-1 Elevation of Flatrock-Haw Creek Watershed



The majority of the watershed has a slope of less than 5% (Figure 2.1-2), although there are areas along the stream systems where the slope increases. The areas where the steeper slopes have been observed are directly along the main sections of water bodies in the watershed.

Figure 2.1-2 Slope in the Flatrock-Haw Creek Watershed



2.2 Hydrology

Hydrology is the study of water in all of its forms, though this plan is focused on streams. The following sections define a watershed, indicate the sub watersheds, streams, locate the legal drains, and the drinking water sources for the residents of the watershed.

2.2.1 Basic Characteristics

A watershed is defined as a topographically delineated area that is drained by a stream or a network of streams. Watersheds are identified by scale and coded as such. Larger watersheds are identified by an eight (8) digit HUC. Slightly smaller watersheds are identified by a ten (10) digit HUC and sub watersheds within the ten digit watersheds are characterized by a twelve (12) digit HUC.

The Flatrock-Haw Creek Watershed is identified by a ten (10) digit HUC (0512020506), and is then subdivided into six (6) sub watersheds (Figure 2.2.1), which are denoted by twelve (12) digit HUCs (Table 2.2.1). In the Flatrock-Haw Creek Watershed; two major water bodies, Flatrock River and Haw Creek, flow into the East Fork White River near the outlet of the watershed. The major tributaries to Haw Creek include Tough Creek and Little Haw Creek. The tributaries to that portion of Flatrock River that fall within the watershed boundaries include Big Slough and Sidney Branch. Including all of the tributaries the watershed contains approximately 109 miles of stream. All the streams in the watershed comprise less than one (1) percent of the total watershed area (Figure 2.2.1).

Figure 2.2.1 Sub watersheds and Streams in Flatrock-Haw Creek Watershed

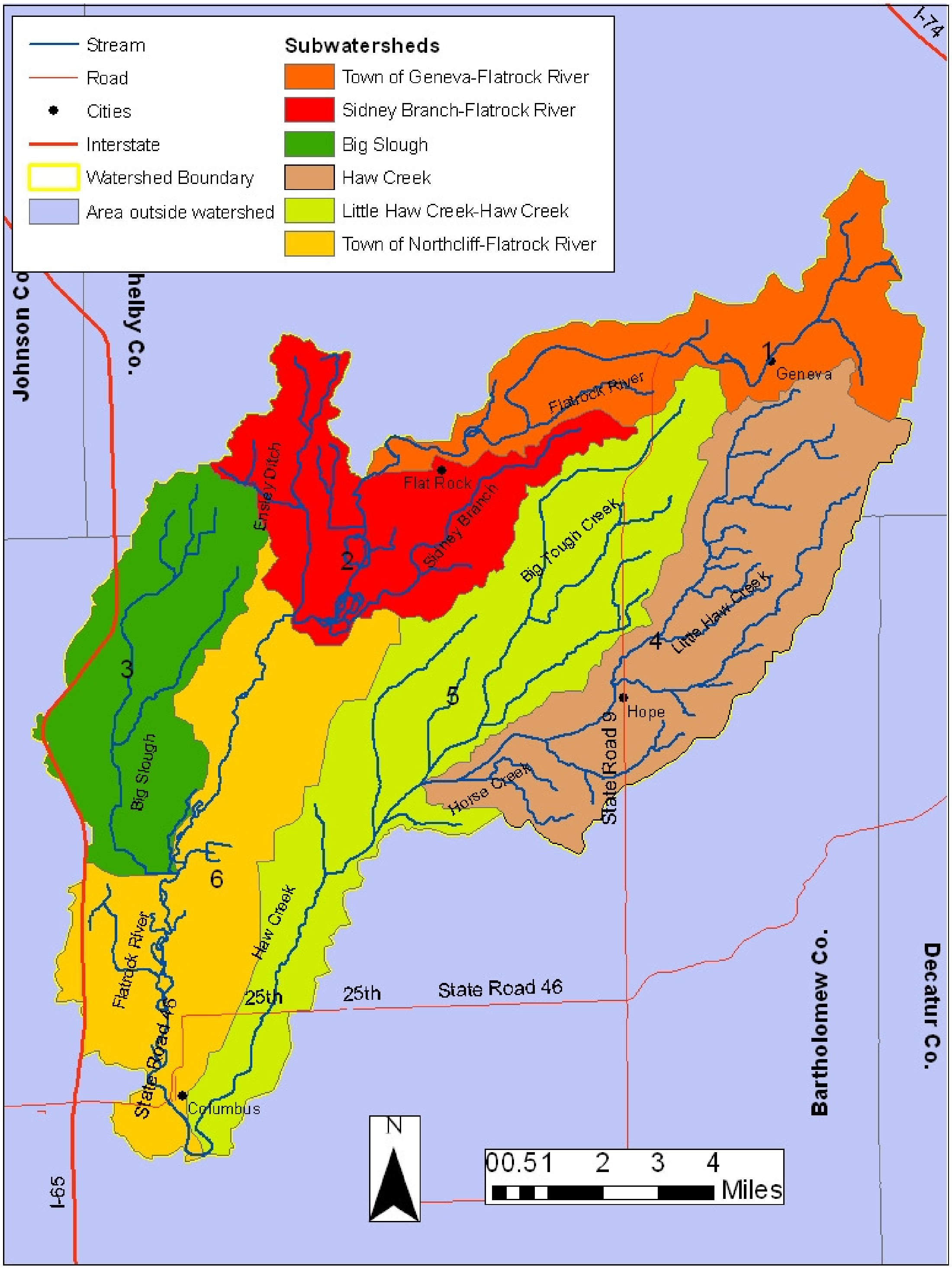


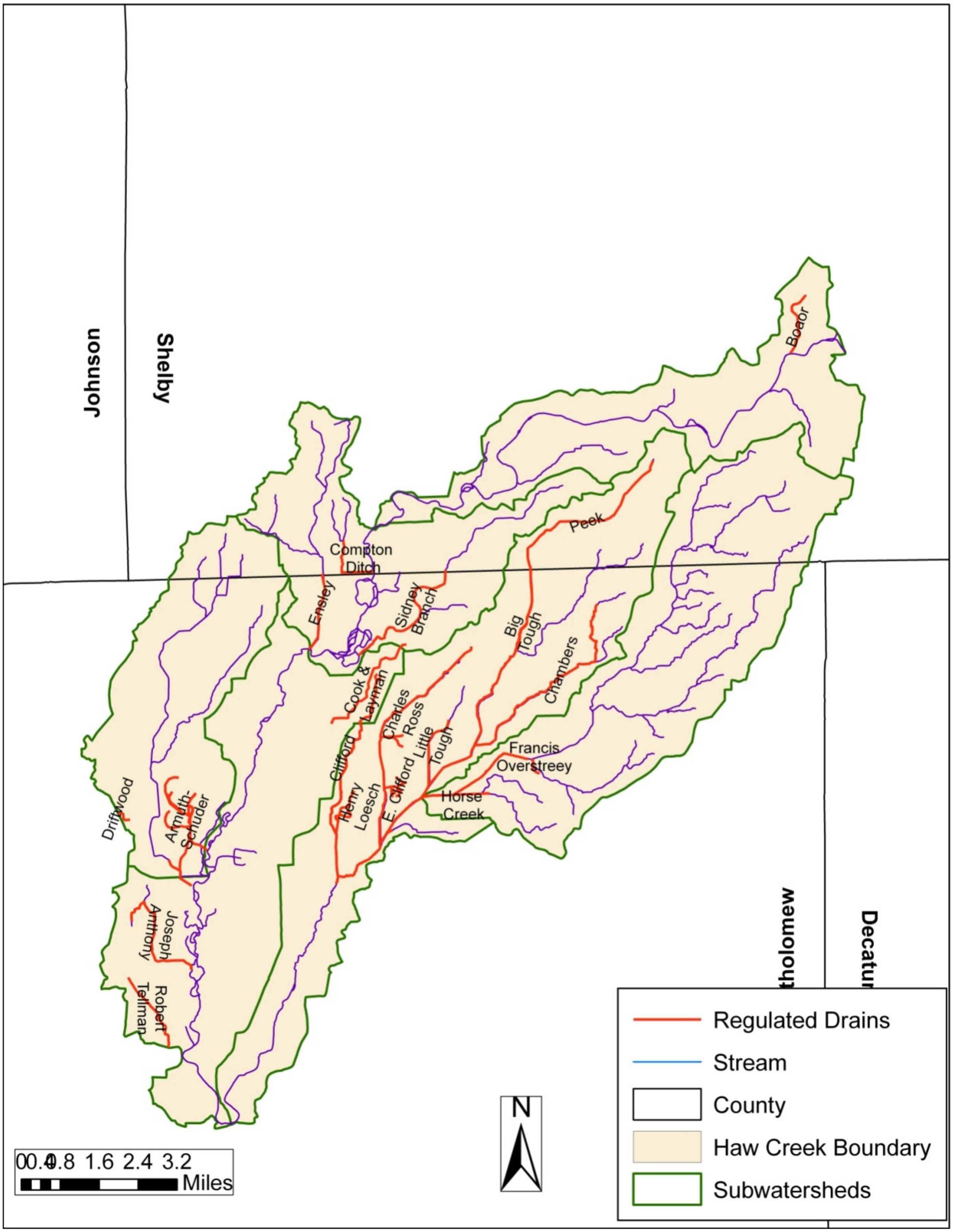
Table 2.2.1 Sub watersheds within the Flatrock-Haw Creek Watershed

Map ID	Sub watershed Name	Area (mi^2)	Acres	12 digit HUC
1	Town of Geneva-Flatrock River	16.72	10,708	051202050601
2	Sidney Branch-Flatrock River	16.7	10,693	051202050602
3	Big Slough	16.52	10,578	051202050603
4	Haw Creek	25.53	16,350	051202050604
5	Little Haw Creek-Haw Creek	31.09	19,910	051202050605
6	Town of Northcliff-Flatrock River	24.41	15,629	051202050606

2.2.2 Legal Drains and Tile Drainage

A legal drain is a regulated waterway that is designed to rapidly transport water to a defined outlet location. In addition to legal drains, extensive, unregulated tile drainage exists in both Bartholomew and Shelby counties. Legal drains are mainly used to direct tile drainage and surface drainage away from fields and homes. Both tile drainage and legal drains can influence the water quality. Increasing the speed of the water movement enhances the ability of the water to pick up sediment and other contaminants while many of the legal drains in the watershed are grassed there is still potential for erosion to occur. Also, tile drainage in adjoining fields can remove water that may contain nutrients such as nitrogen, before it has time to be taken up or denitrified. Bartholomew County has an extensive legal drain system throughout the county with many of these drains located in Flatrock-Haw Creek Watershed. The legal drains in Bartholomew County that fall within the Flatrock-Haw Creek Watershed (Figure 2.2.2) include: Armuth-Schuder , Aaron Essex-Edward Lortz (Big Tough), Albert Reed-Elizabeth Stultz (Chambers), Charles Ross, Clifford, Cook & Layman, Driftwood, East Clifford, Kate Ensley, Francis Overstreey (Haw Creek), Henry Loesch, Horse Creek, Joseph Anthony, Marshall D. Lee (Little Tough), Robert Tellman, and Mary R. Glanton (Sidney Branch). Although Shelby County has an extensive legal drain system as well, few of the legal drains are in the southern portion of the county due to the topography. The three that are located in the watershed include Boaor, Peek (which is the upper portion of Tough Creek), and Compton Ditch (Figure 2.2.2)

Figure 2.2.2 Legal drains in Flatrock-Haw Creek



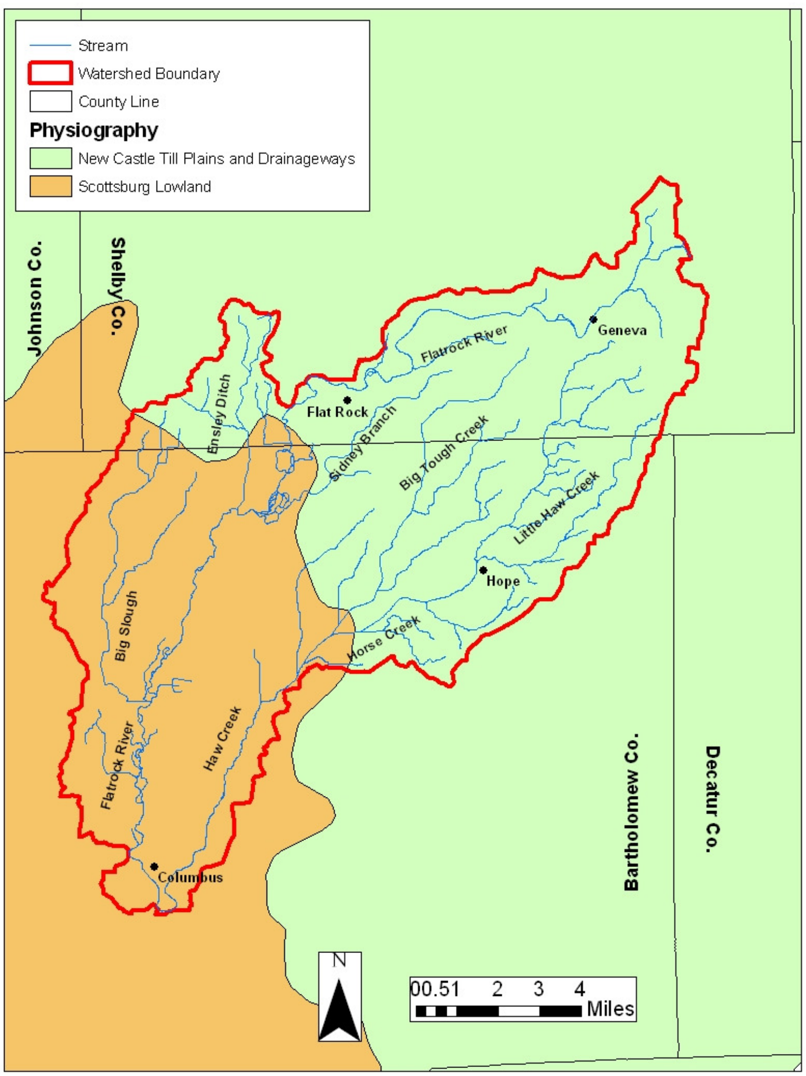
2.2.3 Drinking Water Sources

Drinking water supply in the watershed area is provided by groundwater. The watershed's groundwater wells utilize the White River and Tributaries Outwash Aquifer system. Columbus Utilities currently has seven (7) operating wells located in and around Lincoln Park, which is located in the Town of Northcliff-Flatrock River sub watershed. Eastern Bartholomew also has five (5) operating wells in the watershed located near their office. These fall within the Big Slough sub watershed. Eastern Bartholomew provides water for the smaller communities in Bartholomew County, such as Clifford, Taylorsville, and Hope. Drinking water in Flatrock, Geneva, and the other small communities in Shelby County is provided by private wells.

2.3 Physiography

There are two physiographic regions that are found in the Flatrock-Haw Creek Watershed. These regions are the New Castle Till Plains and Drainageways and the Scottsburg Lowland (Figure 2.3). These two regions serve to divide the upper and lower halves of the watershed. The northern half of the watershed consists of New Castle Till Plain and Drainageways. This region is characterized by till plains formed from glacial deposits. These areas have a low relief with a crisscross pattern of tunnel valleys (Gray, 2000). The southern half of the watershed consists of Scottsburg Lowland. It is also characterized by a low relief, though one controlled by the underlying bedrock. The lowland was formed by shale erosion during the Devonian and early Mississippian ages (Meadows & Bair, 2000). Due to the underlying shale the Scottsburg Lowland area is very susceptible to erosion (Hill, 1998).

Figure 2.3 Physiographic regions in Flatrock-Haw Creek Watershed



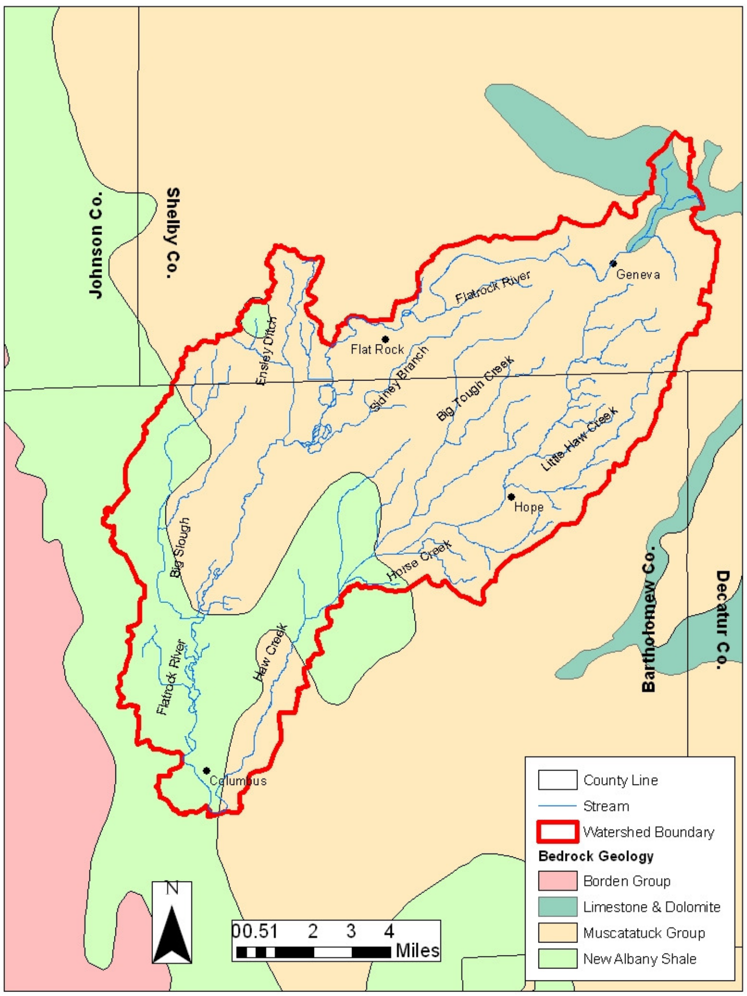
2.4 Geology

All of the bedrock geology in Indiana is a form of sedimentary rock. Sedimentary rocks are rocks formed by the deposition and solidification of sediments and organic matter from pre-existing rocks layers. The surface geology is the parent material for soil formation. Soils influence water quality in their drainage ability and nutrient holding capacity. The poorer drained soils stay saturated for longer periods so if large rain events occur frequently erosion potential also increases.

2.4.1 Bedrock Geology

Flatrock-Haw Creek Watershed consists of Muscatatuck Group, New Albany Shale, and a mix of Limestone and Dolomite geology (Figure 2.4.1). The Muscatatuck Group occurs in approximately three quarters of the watershed and is made up of dolomite and limestone. The New Albany Shale is found in the mid to lower regions of the watershed and consists of black and greenish-gray shale. Finally, the limestone/dolomite mix layer (Louisville Limestone, Brassfield Limestone, Salamonie Dolomite, and Cataract Formation) only occurs along the Flatrock River where it first enters the watershed. As long as there is enough overlying clays this bedrock geology has a low risk of surface to groundwater contamination (Maier, 2004).

Figure 2.4.1 Bedrock geology of Flatrock-Haw Creek Watershed



2.4.2 Surficial Geology

Alluvium constitutes the greater part of the area directly along the main stem of the streams that run through The Flatrock-Haw Creek Watershed. Overall, the bulk of the northern half of the watershed is constituted of loam till and the southern half is dominated by undifferentiated outwash (Figure 2.4.2). Approximately ninety percent of the geology in the watershed dates back to the Wisconsinan Era or earlier, while the stream riparian areas are from the Holocene Era (Table 2.4.2).

Areas where surficial contamination are likely to be highest are the areas where alluvium and outwash occur since these areas typically have less clay and silts deposited over them (Maier, 2004).

Figure 2.4.2 Surficial Geology in the Flatrock-Haw Creek Watershed

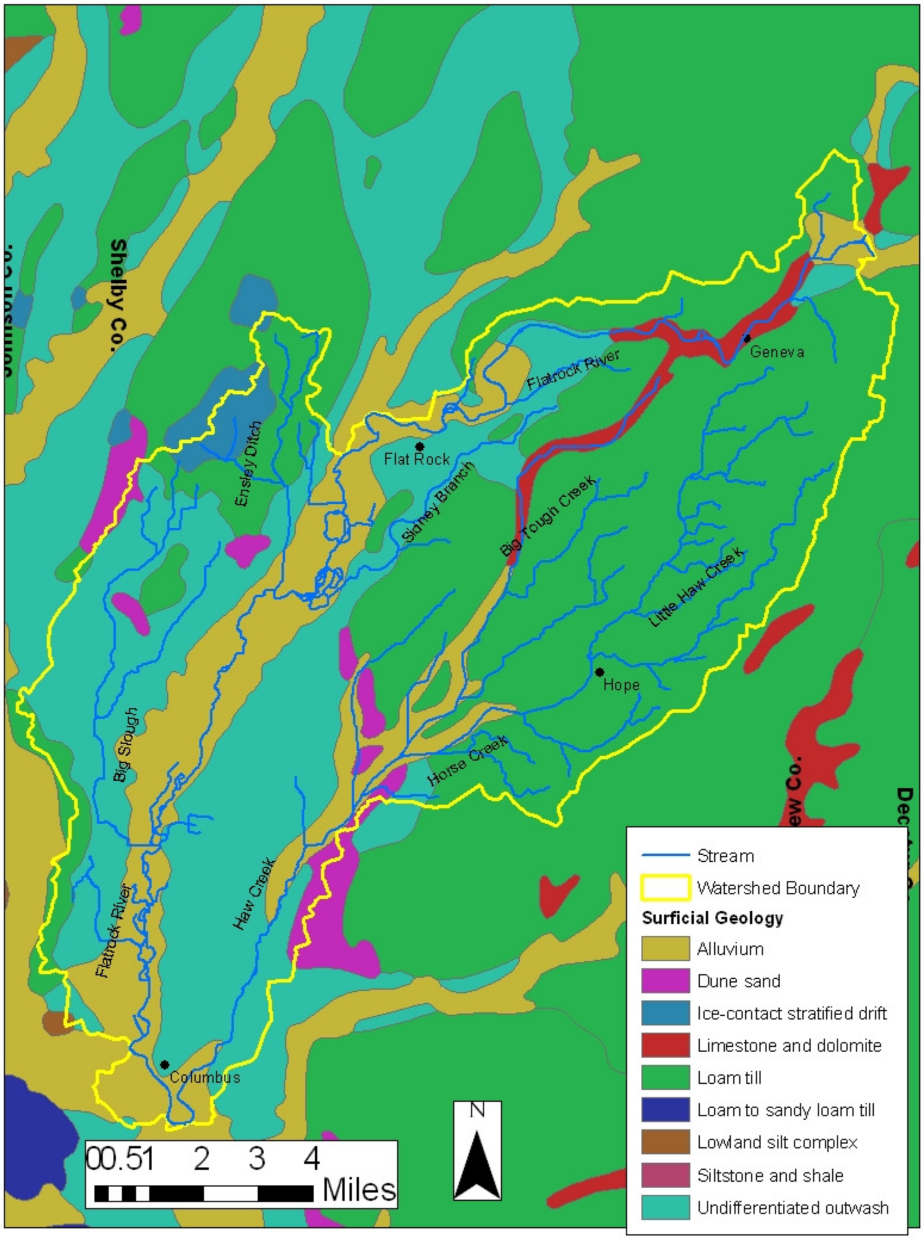


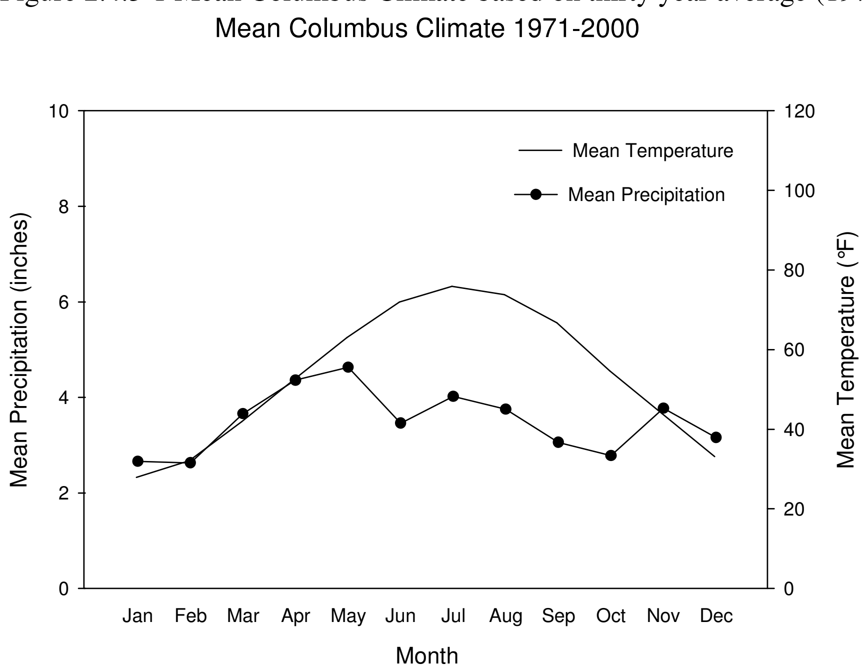
Table 2.4.2 Surficial Geology in the Flatrock-Haw Creek Watershed

Description	**Geologic Era**	**% of Watershed**
Alluvium	Holocene	10
Dune Sand	Wisconsinian to Holocene	1.25
Ice-contact Stratified Drift	Pre-Wisconsinian	1.25
Limestone & Dolomite	Silurian & Devonian	2
Loam Till	Wisconsinian (Pleistocene)	42.5
Lowland Silt Complex	Wisconsinian (Pleistocene)	0.5
Undifferentiated Outwash	Wisconsinian (Pleistocene)	42.5

2.4.3 Watershed leaching potential and local climate

Flatrock-Haw Creek Watershed has no karst within its boundaries, though portions of the watershed are more likely to have a higher leaching potential for pollutants to groundwater due to the surficial geology, particularly during large rain events. The geology where this is most likely to occur is areas of alluvium and outwash where there are little clay and silt deposits (Figure 2.4.2). The highest average monthly precipitation events (Data based on 30 year average from 1971-2000 for the city of Columbus) occur in April, May and November, indicating the portions of the year where the top half of the watershed is more likely to be susceptible to leaching (Figure 2.4.3-1 (NCDC-NOAA, 2008). However, large rain events can happen year round.

Figure 2.4.3-1 Mean Columbus Climate based on thirty year average (1971-2000)



2.5 Soils and Native Vegetation

Since there are 133 different soil series that occur in Flatrock-Haw Creek Watershed, 9 different soil associations are reported in this management plan (Figure 2.5.1, Table 2.5). A soil association is an area with a distinctive proportional pattern of soils. It typically consists of one or more major soils and at least one minor soil and is named for the major soils. Soil associations are useful for general information about the soils in a region or when managing a watershed (USDA, 1991). Different soils have differing water drainage and nutrient holding capacities that can affect water quality. Soils that are poorly drained stay saturated for longer periods of time, making them more susceptible to erosion. 72.5% of the watershed is located within three soil associations, of which all are well to poorly drained soils. The nutrient holding capacity is determined by the soil itself. Clay soils will have more of an ability to hold nutrients than sandy soils. The majority of the soils in the watershed are loams to clay loams, which typically have a better nutrient holding capacity, though there are a few pockets of sandy soils in the watershed. Table 2.5 shows each soil association and the class of native vegetation typically found on that soil. One aspect that determines the native vegetation that flourishes is the soil. The native vegetation seen in this area includes mixed hardwoods (e.g. oak, hickory, maple) and water tolerant hardwoods (e.g. tulip popular, sycamore, cottonwood).

Figure 2.5.1 Soil Associations in Flatrock-Haw Creek Watershed

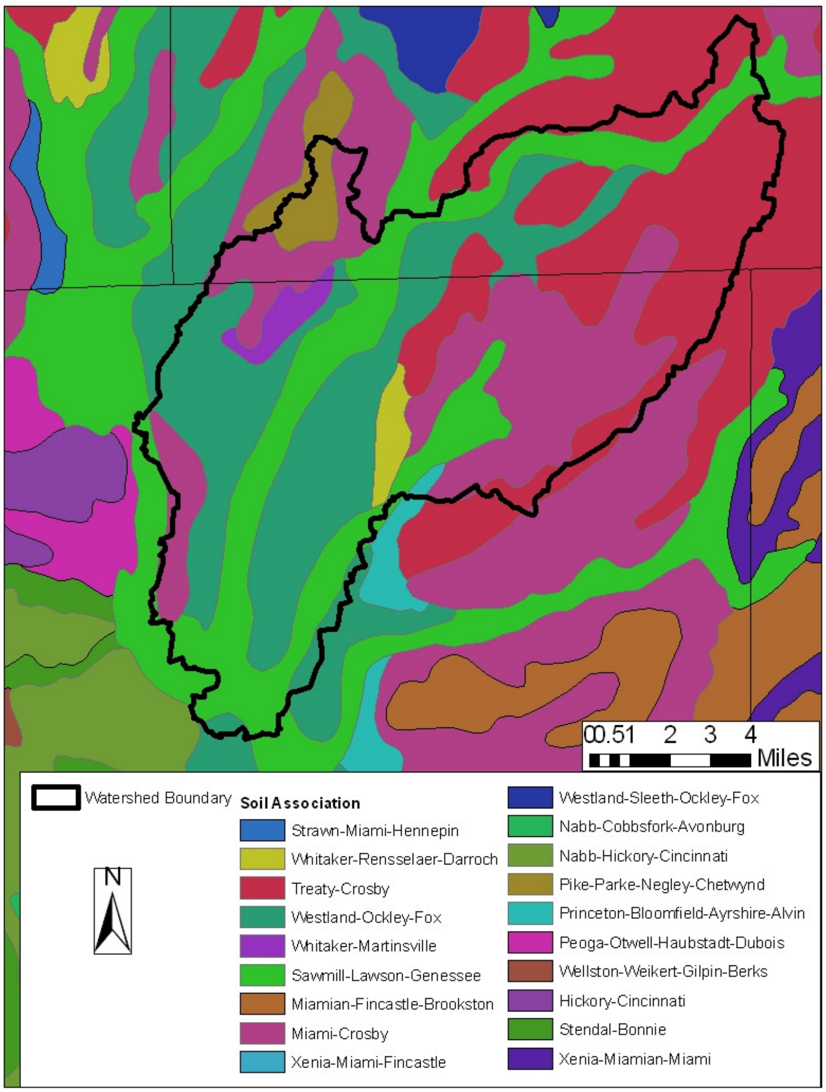


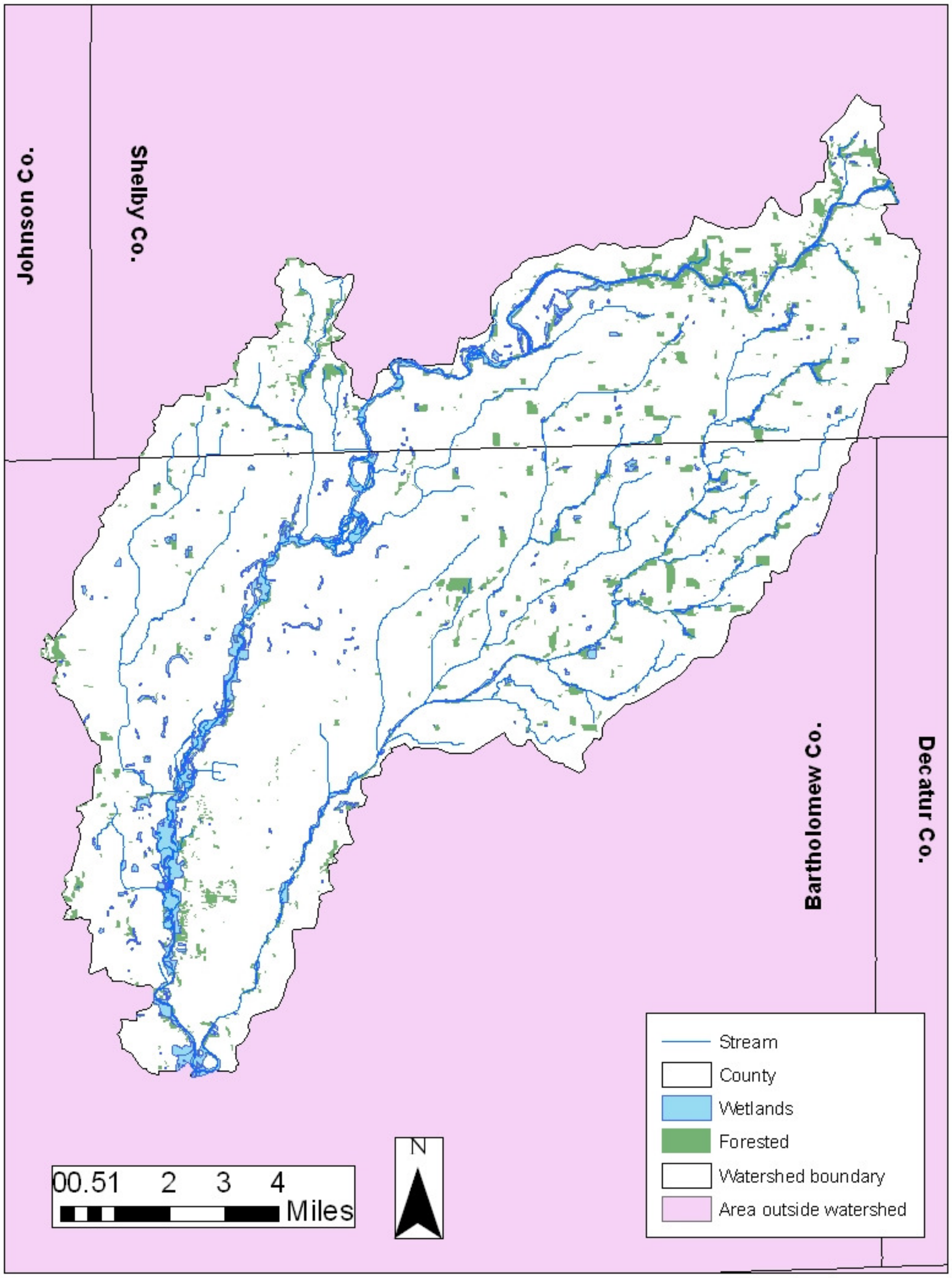
Table 2.5 Soil association characteristics in Flatrock-Haw Creek Watershed

Soil Association	**% of Watershed**	**Characteristics**	**Native Vegetation**
Miami-Crosby	22.0	Deep, well drained to somewhat poorly drained, medium textured, nearly level to strongly sloping soils on uplands.	Mixed hardwoods, water tolerant hardwoods
Pike-Parke-Negley-Chetwynd	1.94	Deep, well drained. Medium textured. Gently sloping to steep on uplands and terraces.	Mixed hardwoods
Princeton-Bloomfield-Ayrshire-Alvin	0.27	Deep, well drained and somewhat poorly drained. Moderately coarse textured and coarse textured. Nearly level to moderately sloping soils on uplands.	Mixed hardwoods
Nabb-Hickory-Cincinnati	0.002	Deep, moderately well drained. Medium textured and nearly level to steep slopes.	Mixed hardwoods
Sawmill-Lawson-Genessee	21.8	Deep, well drained to somewhat poorly drained. Nearly level to strongly sloping soils on uplands.	Mixed hardwoods
Treaty-Crosby	23.1	Somewhat poorly drained and very poorly drained soils. Nearly level. Formed in loess and glacial till on uplands.	Mixed hardwoods, water tolerant hardwoods
Westland-Ockley-Fox	27.6	Well drained, very poorly drained and somewhat poorly drained. Nearly level and gently sloping. Formed in glacial outwash on terraces and outwash plains.	Mixed hardwoods, water tolerant hardwoods
Whitaker-Martinsville	1.7	Deep, well drained and somewhat poorly drained. Medium textured and moderately coarse textured. Nearly level and gently sloping soils on terraces.	Mixed hardwoods
Whitaker-Rensselaer-Darroch	1.5	Deep, somewhat poorly drained to very poorly drained. Medium and moderately fine textured. Nearly level and gently sloping soils that formed in loess and in glacial till or outwash.	Mixed hardwoods, water tolerant hardwoods

2.6 Wetlands and Forestland

Based on the National Wetland Inventory Data, wetlands in the watershed make up approximately 0.15% of the land use. USGS land use data shows forested areas consist of 8.0% of the total land use. The forested areas are scattered with the majority of them located along the streams in the watershed (Figure 2.6).

Figure 2.6 Wetlands and Forestland in Flatrock-Haw Creek Watershed



2.7 Threatened and Endangered Species

Out of the five hundred ninety-five (595) endangered and threatened species in Indiana there are forty-eight (48) that are known to be in either Bartholomew or Shelby counties (Table 2.7). Of the forty-eight (48) that can potentially be found in Flatrock-Haw Creek Watershed, twenty (20) of them are listed as state endangered and eighteen (18) are listed as state special concern. The rest are listed as threatened, rare or on a watch list for the future. Also, out of the forty–eight (48) on the list there are 5 that are on the federal threatened and endangered list (4 endangered and 1 threatened).

Table 2.7 Threatened and Endangered Species

Common Name	State Rank	Federal Rank	Habitat	County
Vascular Plants				
Spreading Rockcress	SE	**	Limestone creek banks	Bartholomew
Straw Sedge	ST	**	Open woods by ponds	Bartholomew
Illinois Hawthorn	SE	**	Well drained woods, fields and brushland	Bartholomew
Butternut	WL	**	Terraces and banks of streams	Bartholomew
Cattail Gay-Feather	ST	**	Prairies	Bartholomew
Small Sundrops	SR	**	Hard, white clay soil	Bartholomew
A Panic-grass	SE	**	Dry wooded slopes	Bartholomew
Gray beardtongue	SE	**	White oak slopes	Bartholomew
Smith's Bulrush	SE	**	Wet, sandy borders of lakes and sloughs	Bartholomew
Branching Bur-Reed	ST	**	Wet areas (not well known)	Bartholomew
Yellow Nodding Ladies'-Tresses	ST	**	Dry rocky roadcuts and old fields	Bartholomew
American Ginseng	WL	**	Well drained woods	Bartholomew
Mussels				
Eastern Fanshell Pearlymussel	SE	LE	Medium to large rivers in gravel riffles	Bartholomew
Northern Riffleshell	SE	LE	Medium to large rivers in gravel riffles	Shelby
Snuffbox	SE	**	Medium to large rivers in clear, gravel riffles	Bartholomew, Shelby
Wavyrayed Lampmussel	SSC	**	Medium-sized streams in gravel riffles	Bartholomew, Shelby
Kidneyshell	SSC	**	Medium to large rivers in gravel	Bartholomew, Shelby
Rabbitsfoot	SE	**	Medium to large rivers in mixed sand and gravel	Bartholomew, Shelby
Round Hickorynut	SSC	**	Medium-sized streams in sand and gravel in areas with moderate flow	Bartholomew
Clubshell	SE	LE	Medium to large rivers in gravel or mixed gravel/sand	Bartholomew, Shelby
Pyramid Pigtoe	SE	**	Medium to large rivers in sand or gravel in areas with a good current	Bartholomew
Salamander Mussel	SSC	**	Medium to large rivers on mud or gravel bars	Shelby
Purple Lilliput	SSC	**	Lakes and small to medium streams in gravel	Bartholomew, Shelby
Little Spectaclecase	SSC	**	Small to medium streams in sand or gravel	Bartholomew, Shelby
Reptiles				
Kirtland's Snake	SE	**	Wet, grassy areas along waterways (adaptable in urban settings)	Bartholomew
Birds				
Bachman's Sparrow	SXB	**	Dry, open woodlands	Bartholomew
Henslow's Sparrow	SE	**	Wet, shrubby fields and grasslands	Bartholomew

Common Name	State Rank	Federal Rank	Habitat	County
Great Blue Heron	*	**	Edge of water bodies	Bartholomew
Red-shouldered Hawk	SSC	**	Moist, mixed woodlands	Bartholomew
Sedge Wren	SE	**	Wet meadows and sedge marshes	Bartholomew
Peregrine Falcon	SE	No status	Open wetlands near cliffs	Bartholomew
Worm-Eating Warbler	SSC	**	Dense undergrowth on wooded slopes	Bartholomew
Black and White Warbler	SSC	**	Mixed woodlands	Bartholomew
Black-Crowned Night-Heron	SE	**	Edge of water bodies	Bartholomew
Barn Owl	SE	**	Open woodlands	Bartholomew
Bald Eagle	SE	LT, PDL	Large woods near water bodies	Bartholomew
Hooded Warbler	SSC	**	Small clearings with thick underbrush	Bartholomew
Mammals				
Bobcat	SSC	No status	Remote hilly forests	Bartholomew
Indiana Bat	SE	LE	Streams with deciduous forests	Bartholomew
Evening Bat	SE	**	Variety of habitats	Bartholomew
Northern River Otter	SSC	**	Medium to large streams and rivers	Shelby
Eastern Red Bat	SSC	**	Open spaces, along narrow streams and roads	Bartholomew
Hoary Bat	SSC	No status	Coniferous forests for roosting, open areas and lakes for feeding	Bartholomew
Little Brown Bat	SSC	No status	Near water, over winter in caves	Bartholomew
Northern Myotis	SSC	**	Forested hills and ridges, over winter in caves	Bartholomew
Eastern Pipistrelle	SSC	**	Edges of forests near streams, over winter in caves	Bartholomew
American Badger	SSC	**	Dry fields and pasture	Bartholomew, Shelby
Insects				
Turquoise Bluet	SR	**	Slow moving streams, ponds and lakes	Shelby

State: SX=state extirpated, SE=state endangered, ST=state threatened, SR=state rare, SSC=state special concern, WL=watch list, SG=state significant, B=breeding status, *=no status but rarity warrants concern
Federal: LE=endangered, LT=threatened, LELT=different listings for specific ranges of species, PE=proposed endangered, PT=proposed threatened, E/SA=appearance similar to LE species, PDL=proposed for delisting, **= not listed; Indiana DNR, 2008.

3.0 Land Use

3.1 Natural History and Human Influence

The Flatrock-Haw Creek Watershed was originally inhabited by a number of Indian tribes, with the Miami and the Delaware being the two main tribes of the region. At the time Indiana became a state in 1816, the area around Flatrock-Haw Creek Watershed was owned by the Delaware Indians. They had first moved into the area in the later part of the eighteenth century from eastern Ohio (Bartholomew County Historical Society, 1976). By way of the St. Mary's Treaty, the Delaware's title to the land was extinguished in 1818 and white settlement began. The first settlers included General John Tipton, John Lindsey and Luke Bonesteel who came to the area in 1820 (Somerset Publishers, 1993).

Bartholomew and Shelby counties, in which Flatrock-Haw Creek Watershed, were both established in 1821. Bartholomew County was named for General Joseph Bartholomew while Shelby County was named for General Isaac Shelby.

The first railroad in Indiana was built in 1834 with part of it running through the northern portion of Shelby County. A railroad was built from the Ohio River to Indianapolis, going through Columbus in 1843 (Bartholomew County Historical Society, 1976).

The watershed land use is currently 78% agricultural, but in the mid 1800's it was even more agriculturally oriented. The town of Columbus, currently the largest town within the watershed boundary, was very rural in the mid 1850's. Upon moving to the area Reverend Dickey noted:

"*There were a few houses on Washington Street and on the street west of it, north of the railroad, but for several years after I became a citizen of this place, most of the ground north of the Madison railroad and east of Washington Street was under cultivation in a field or stood with forest trees on it"* (Bartholomew County Historical Society, 1976).

3.2 Existing Landscape

While population is continuously growing, the urban growth is only occurring within currently established towns. The major urban areas that fall within the boundaries include Columbus (Pop. 39,690), Flat Rock (Pop. 1,539), Taylorsville (Pop. 942), Clifford (Pop. 291), Hope (Pop. 2140), and Geneva (Pop. 1,368). There are also many other smaller towns that fall within the watershed boundary. The majority of the land use is agriculture, either pasture/hay or rotational cropland (Figure 3.2). Areas that are agricultural may include filter strips, riparian buffers, grass waterways, and wildlife habitat. Developed land makes up the next largest percentage of land use in the watershed (Table 3.2). Although 13.6% of the land is developed only 6% of this is urban/suburban of low to high intensity. The other portion is developed open space. Developed open space includes areas such as parks, golf courses, large lot single family housing units, and the grass areas around developed areas for recreation and erosion control. Typically, these areas have less than twenty (20) percent impervious surfaces.

Figure 3.2 Current land uses in the Flatrock-Haw Creek Watershed.

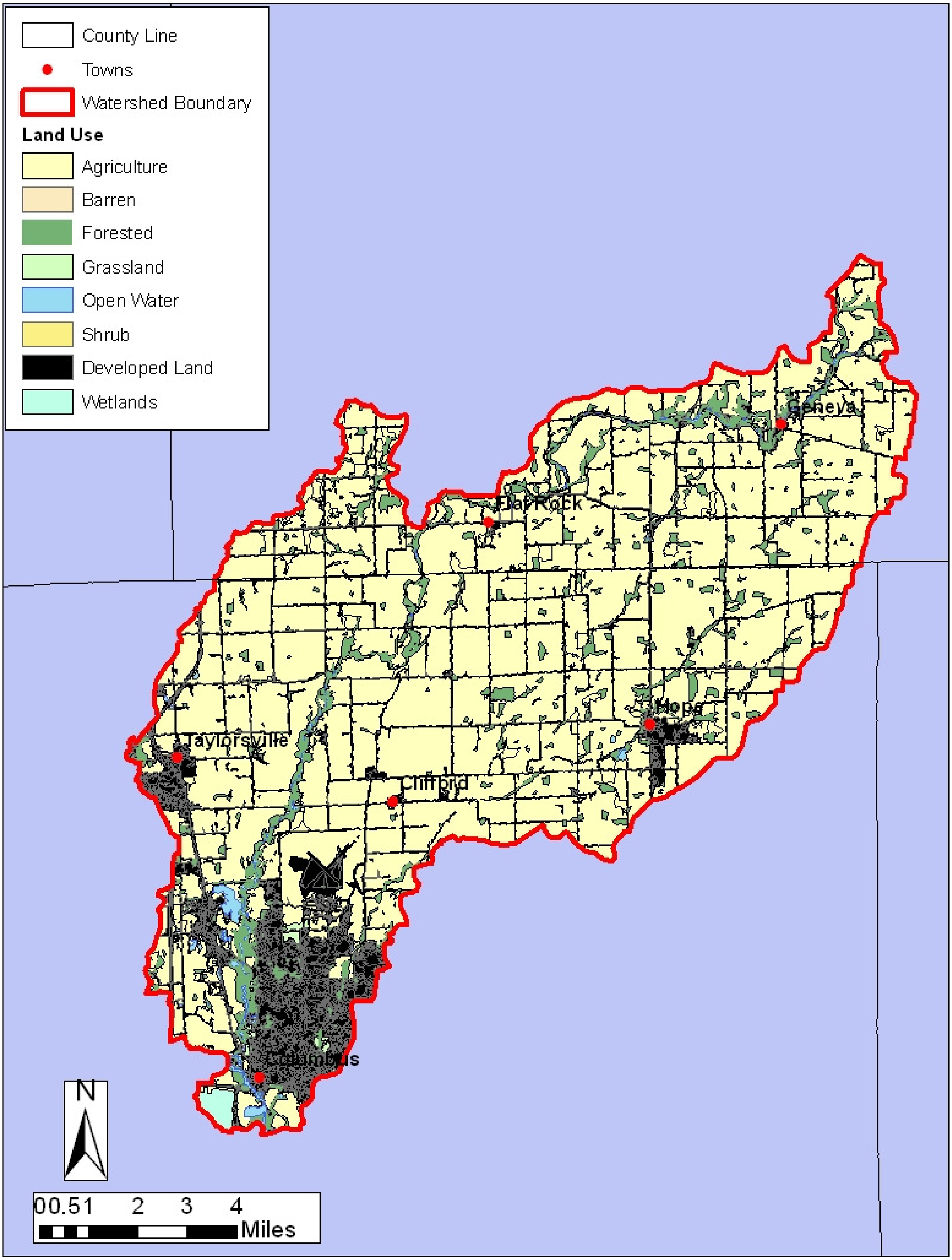


Table 3.2 Land use in Flatrock-Haw Creek Watershed

Land Use	Acres	% of Watershed
Open Water	629.01	0.75%
Developed Land	11,338.95	13.52%
Barren	0.84	<0.01 %
Forested	6,709.44	8.00%
Shrub	4.19	<0.01%
Grassland	218.06	0.26%
Agriculture	64,804.80	77.27%
Wetlands	159.35	0.19%

Percentages derived from 1999 USGS land cover dataset

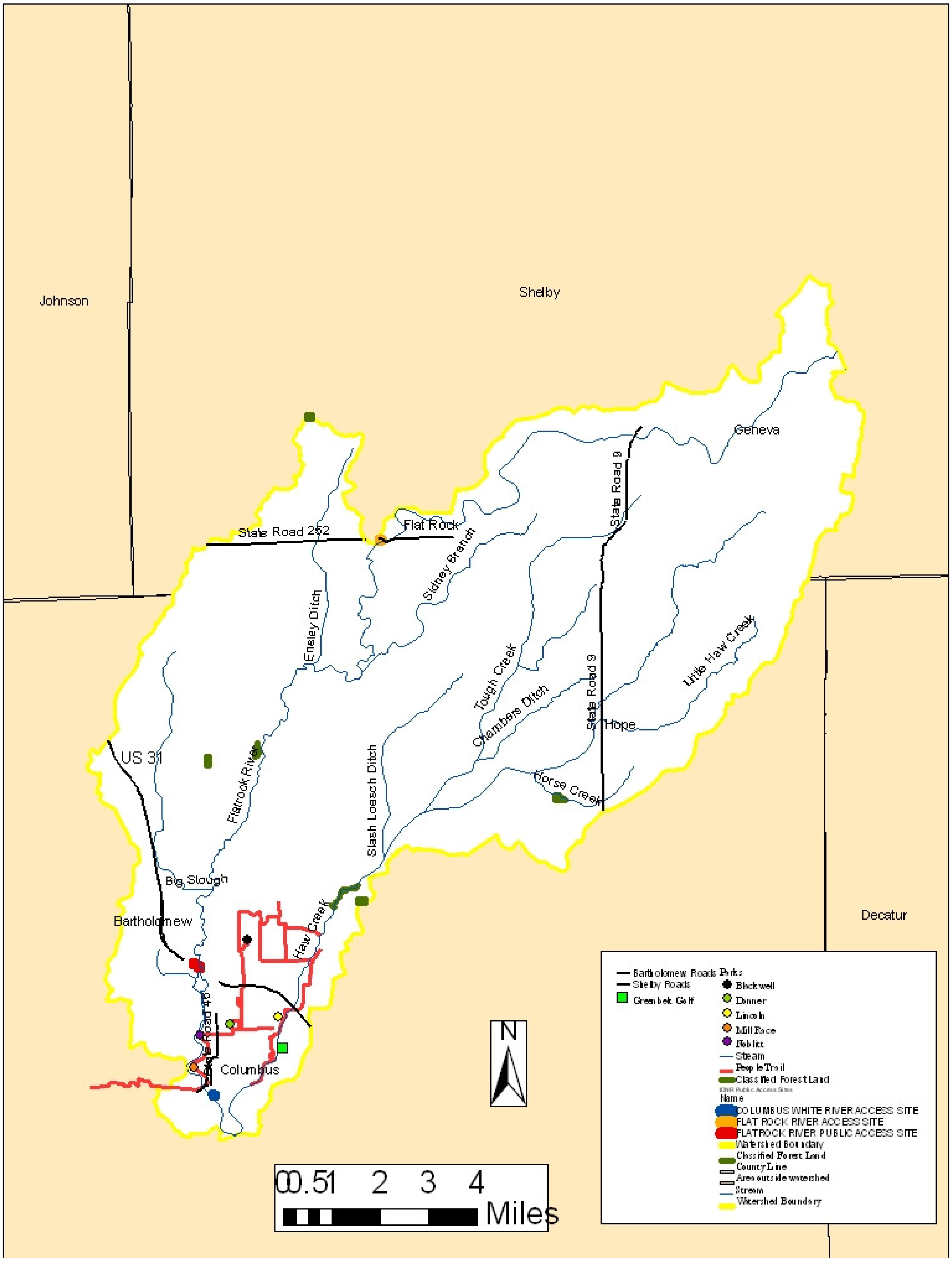
3.3 Land Ownership

The majority of the Flatrock River in our watershed is a state designated canoe trail. The Indiana Department of Natural Resources (Indiana DNR) maintains three public access river sites in the watershed. (Figure 3.3). The watershed also contains approximately 111 acres of classified forest. To be labeled as a classified forest an area must be entered into the Indiana Classified Forest and Wildlands Program through Indiana DNR. The program defines a classified forest as:

"*Areas of 10 acres or more, supporting a growth of native or planted trees, which have been set aside for the production of timber and wildlife, the protection of watersheds, or the control of soil erosion. The owner of classified forest land does not relinquish ownership or control of his property and Division of Forestry does not become connected in any way with the ownership of the land.*"

Other land ownership includes city parks and city trails (e.g. The People Trail) which are maintained by each town's park and recreation department. City Parks include Blackwell Park, Donner Center, Lincoln Park, Mill Race Park, and Noblitt Park. There are also 2 golf courses in the watershed; Greenbelt and Par 3 Golf Course.

Figure 3.3 Land Ownership in the Flatrock-Haw Creek Watershed



3.4 Point Source Discharge and Regulated Permits

Although the Flatrock-Haw Creek Watershed Project focuses largely on nonpoint source pollution there are regulated, point sources that also influence the water quality. Point source pollution is from a defined source, such as a waste water treatment plant or industry, and is regulated through the National Pollution Discharge Elimination System (NPDES). Nonpoint source pollution is from a diffuse source, making it more difficult to pinpoint the contamination source(s). The planning process for the project is non-regulatory; community led and is intended to improve the water quality in Flatrock-Haw Creek Watershed. A few ways in which the project will promote better water quality is through promotion of Best Management Practices (BMPs), community involvement, and widespread education about water quality issues. Effluents leaving NPDES facilities are regularly self-monitored to ensure compliance of water quality standards established by the State of Indiana. These water quality reports are then reported to IDEM and available for public view. In 2009, Flatrock-Haw Creek Watershed had ten (10) active point source dischargers in the watershed. Table 3.4.1 and Figure 3.4 identify the permit information for both the active NPDES facilities and pipes. Table 3.4.2 shows the permit information about what the NPDES facilities are discharging and the number of effluent exceedances that have occurred over the last three years.

In addition to NPDES permits the state regulates confined feeding operations (CFOs). These operations are designated as Confined Feeding Operations (CFOs) based on livestock type and size of the operation. In 2009 there were thirteen (13) active CFOs (8 in Bartholomew County and 5 in Shelby County) in Flatrock-Haw Creek Watershed (Figure 3.4). Of the thirteen (13) CFOs, four (4) are registered Concentrated Animal Feeding Operations (CAFOs). Registered CAFOs are larger facilities that are federally regulated operations while smaller, CFO's are state regulated.

The City of Columbus is currently in the process of correcting the long-standing Combined Sewer Overflow (CSO) as required by State's long term control plan. The CSO's are direct discharges of untreated waste into local waters during high storm-flow events. This is due to the system not being able to handle the combination of sewer and rainfall amounts. To achieve the goal of ending the CSO discharges, the City of Columbus contracted work in 2007 to increase the diameter of the sewer, include storm pretreatment, and build a new Waste Water Treatment Plant to addressing system capacity issues. The completion of this project is expected in 2011.

Table 3.4.1 Active NPDES Pipes

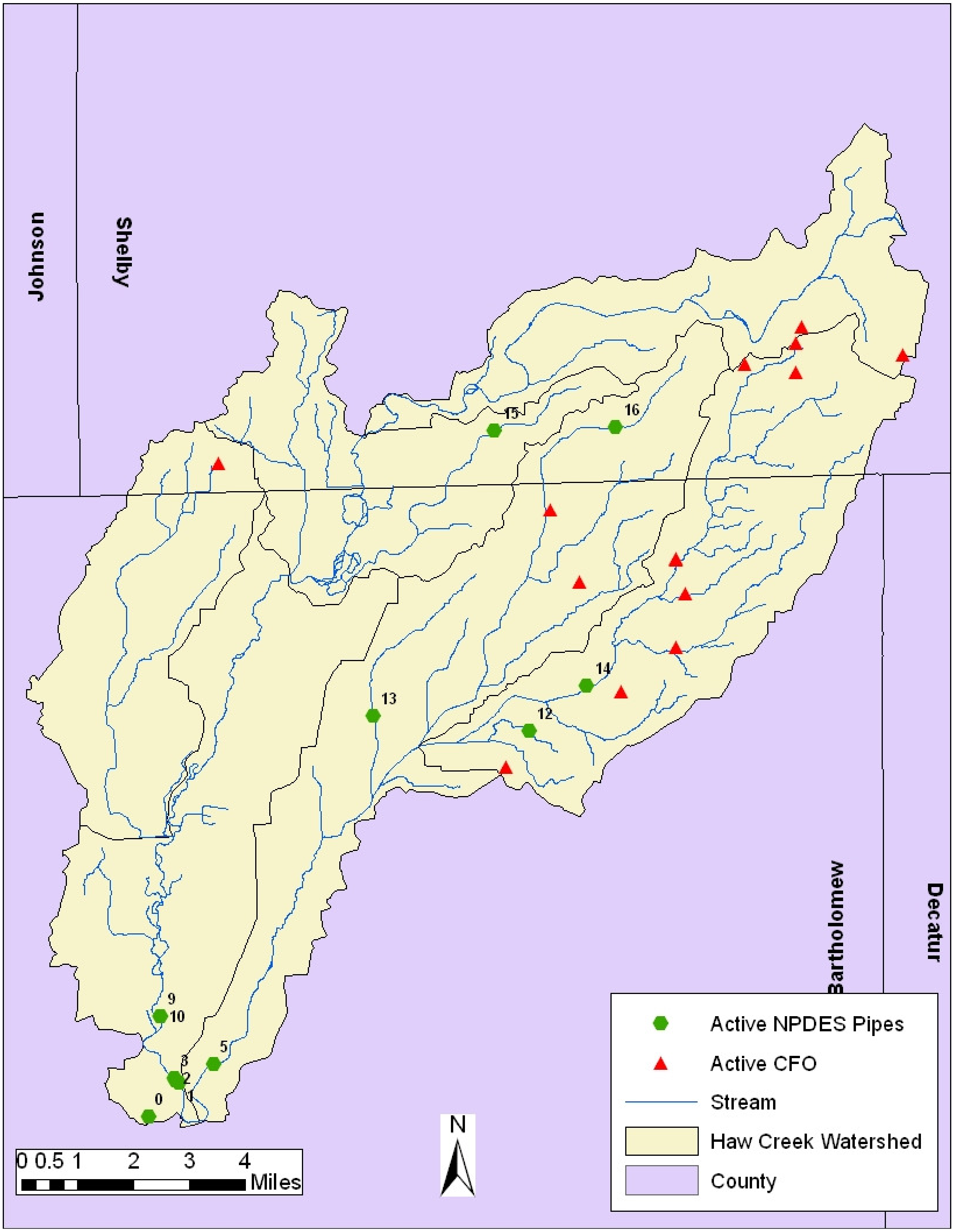
Permit #	Map Number	Permit Holder	County	Description
ING080039	0	Garden City Save	Bartholomew	Groundwater Petroleum Remediation
IN0032573	1	Columbus Municipal Sewage Treatment Plant	Bartholomew	Combined Sewer Overflow, Maple Grove
IN0032573	2	Columbus Municipal Sewage Treatment Plant	Bartholomew	Municipal STP, Main Plant Discharge
IN0032573	3	Columbus Municipal Sewage Treatment Plant	Bartholomew	Combined Sewer Overflow
ING250075	5	Cummins	Bartholomew	Storm water & Groundwater Remediation
IN0032573	9	Columbus Municipal Sewage Treatment Plant	Bartholomew	East Fork White River/Flat Rock River
IN0032573	10	Columbus Municipal Sewage Treatment Plant	Bartholomew	Combined Sewer Overflow, Noblitt Park
IN0045748	12	Wood Products, LLP	Bartholomew	Wood Products Discharge
IN0031551	13	Cross Cliff Elementary School	Bartholomew	Slash Ditch
IN0021253	14	Hope Municipal Sewage Treatment Plant	Bartholomew	Controlled Discharge, lagoon
IN490091	15	Ward Stone LLC	Shelby	Quarry
IN490083	16	Heritage Aggregates	Shelby	Near Flat Rock

Table 3.4.2 NPDES Facilities violations

Permit #	Permit Holder	County	Permit Type	Effluent Exceedances (7/06-6/09)
IN0032573	City of Columbus Waste Water Treatment Plant	Bartholomew	Standard Wastewater	14 E.coli, 1 TSS
IN0031551	Cross Cliff Elementary School	Bartholomew	Standard Wastewater	1 TN, 2 TSS
ING250075	Cummins Engine Co.	Bartholomew	Standard Wastewater	No data available
ING080039	Garden City Save Tobacco RD 6	Bartholomew	General	No data available
IN0021253	Hope Waste Water Treatment Plant	Bartholomew	Effective	14 pH, 8 BOD, 2 TN, 2 TSS
ING490091	Ward Stone Quarry	Shelby	General	6 pH, 6 TSS

TSS-Total Suspended Solids
TN-Nitrogen and Ammonia (total Nitrogen)
BOD-Biochemical Oxygen Demand

Figure 3.4 Location of NPDES pipes and CFOs in Flatrock-Haw Creek

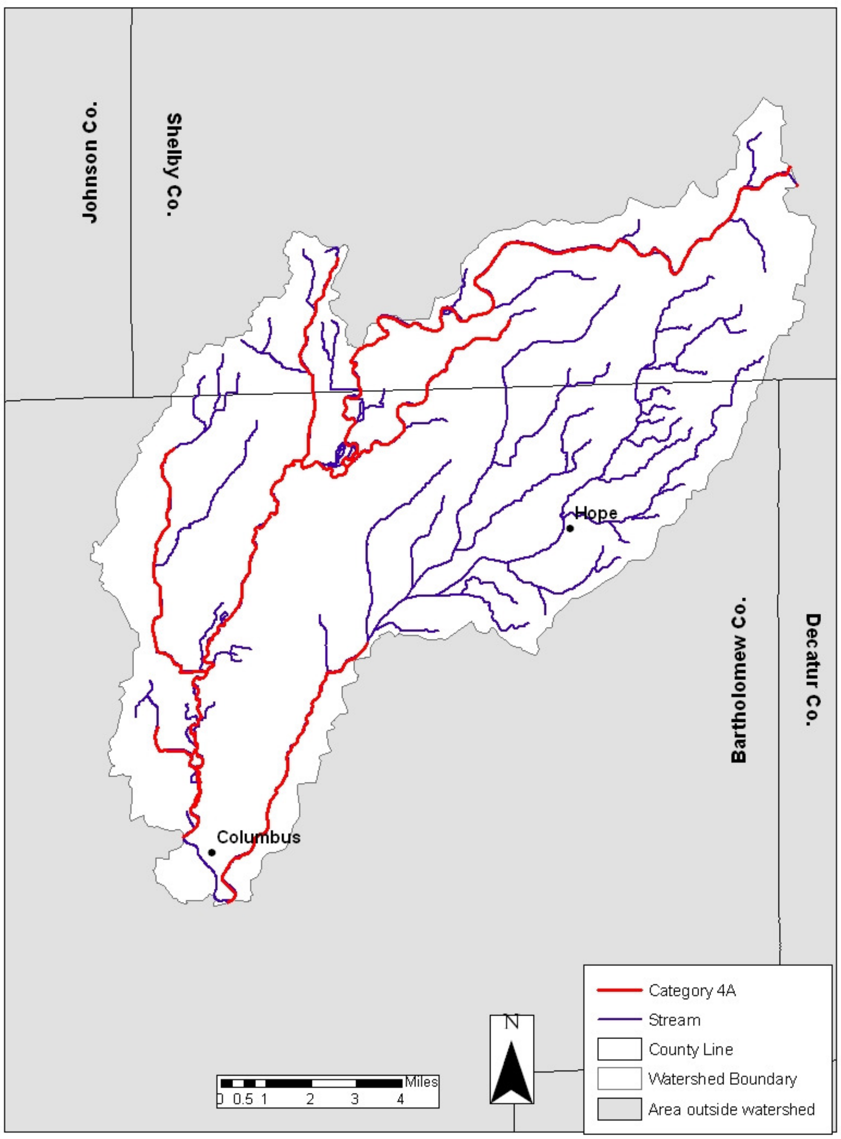


4.0 Investigation of Water Quality Issues and Benchmarks

4.1 Designated Use, Assessment, and Impairment

Due to the Clean Water Act (1977) states are required to assess the quality of its stream segments to show compliance for state water quality standards. If a stream segment fails to meet the required standard it is listed on a 303(d) list created by the State regulating agency. In Indiana the Indiana Department of Environmental Management (IDEM) regulates the state's waterbodies. These standards are set based on specific uses, which are aquatic life, human health (drinking), and recreation (swimming, fishing). If it is determined that stream segments in a watershed do not meet the water quality standards a Total Maximum Daily Load (TMDL) document is developed. In 2005 a TMDL for E. coli was developed for the larger Flatrock-Haw Creek Basin (HUC 05120205). Once a TMDL is developed the streams are no longer categorized as 303d impaired streams, they are listed as category 4A streams.

Figure 4.1 Segments in Flatrock-Haw Creek listed on the 2008 Category 4A Streams



In 2008, twenty (20) segments of Flatrock-Haw Creek Watershed were listed on the Category 4A list for E. coli. These segments include the entire length of Flatrock River that is in the watershed, the lower portion of Haw Creek, Big Slough, Ensley Ditch, and Sidney Branch. This indicates that these segments do not meet state water quality standards for full body water contact. These segments are currently listed in the 2005 TMDL that was developed for the larger (10 digit) Flatrock-Haw Creek Basin.

4.2 Land Inventory

Flatrock-Haw Creek Watershed drains approximately 83,868 acres which includes agricultural, urban/suburban, and industrial areas in two counties. Different land uses influence the water quality in the watershed (Table 4.2). While most of the land is agricultural in use, the majority of the urban area of Columbus is encompassed in the watershed boundaries (See section 3 for details).

Table 4.2 Specific land use of Flatrock-Haw Creek

Land Use	% of Watershed	Acres	Category
Open water	0.75%	629.01	Water
Developed, open space	7.44%	6,239.78	Urban/Suburban
Developed, low intensity urban	3.84%	3,220.53	
Developed, medium intensity urban	1.49%	1,249.63	
Developed, high intensity urban	0.75%	629.01	
Barren	0.001%	0.84	Natural Vegetation
Deciduous forest	7.95%	6,667.51	
Evergreen forest	0.05%	41.93	
Mixed forest	0.002%	1.68	
Shrub	0.005%	4.19	
Grassland	0.26%	218.06	
Pasture/Hay	2.83%	2,373.46	Agriculture
Row crop	74.44%	62,431.34	
Woody wetlands	0.14%	117.41	Wetlands
Emergent herbaceous wetlands	0.05%	41.93	

Percentages from 1999 USGS land cover

4.2.1 Agricultural Practices

The majority of agricultural practices are row crop (corn, soybean) (Table 4.2.1-1). Typically, crops are grown on flatter or slightly rolling areas where steep areas are used for pasture or allowed to re-grow with natural vegetation.

Table 4.2.1-1 2007 Crop yields by county

County	**Corn**		**Soybeans**	
	Acres	**Yield (bushels)**	**Acres**	**Yield (bushels)**
Bartholomew	73,700	139	59,800	35
Shelby	106,700	128	87,400	37
	Wheat		**Hay**	
	Acres	**Yield (bushels)**	**Acres**	**Yield (tons)**
Bartholomew	4,500	60	4,000	2.17
Shelby	3,400	59	3,400	1.91

Agricultural Statistics, 2007-2008

In no-till/strip-till systems a field is left undisturbed from harvest through planting with the exception of strips up to 1/3 of the row width. Planting or drilling is done using disc openers, coulters, row cleaners, in-row chisels or roto-tillers. In addition, farmers can utilize mulch till, which is full width tillage where during one or more tillage trips the entire soil surface is disturbed prior to planting. In both conservation tillage practices residue cover greater than 30% is left. Reduced tillage is where during one or more tillage trips the entire soil surface is disturbed prior to planting, but there is a 15-30% residue cover left after planting. A final tillage practice used in the watershed is conventional tillage. With this method a farmer conducts full width tillage disturbing the entire soil surface before planting leaving less than a 15% residue cover after planting (CTIC, 2002).

While not used county wide there are areas in the counties that use no-till and mulch-till technology, which helps water quality by reducing soil erosion (Table 4.2.1, Figure 4.2.1-1 through 4.2.4:1-4). These values are based on the most recent data, but as illustrated in the figures below no-till practices have been gaining in use since 1990.

Table 4.2.1 Tillage practices by county and crop

County/Crop	No-till (%)	Mulch till (%)	Reduced till (%)	Conventional till (%)
Bartholomew/corn (2007)	48	12	5	35
Bartholomew/soybeans (2007)	73	11	5	11
Shelby/corn (2008)	38	51	7	4
Shelby/soybeans (2008)	95	3	1	1

Figure 4.2.1-1 Bartholomew tillage practices for corn

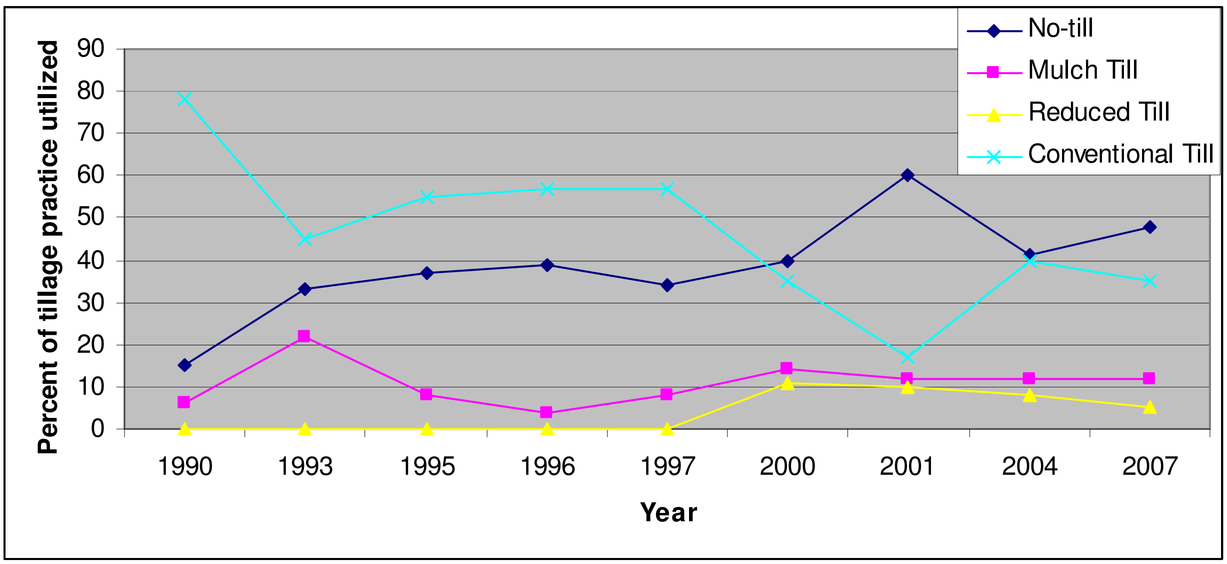


Figure 4.2.1-2 Shelby tillage practices for corn

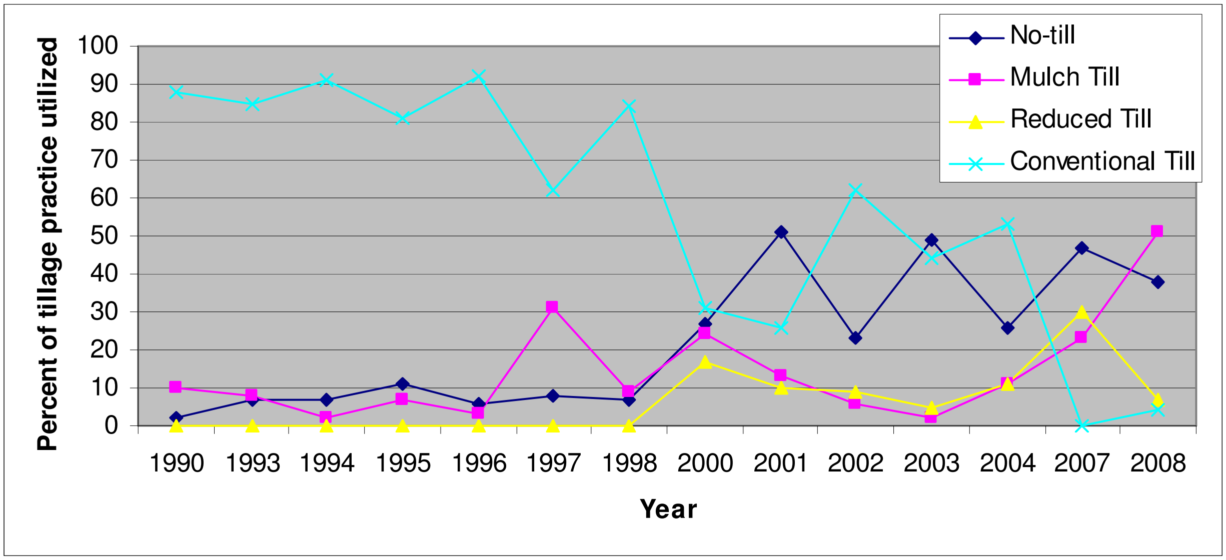


Figure 4.2.1-3 Bartholomew tillage practices for soybeans

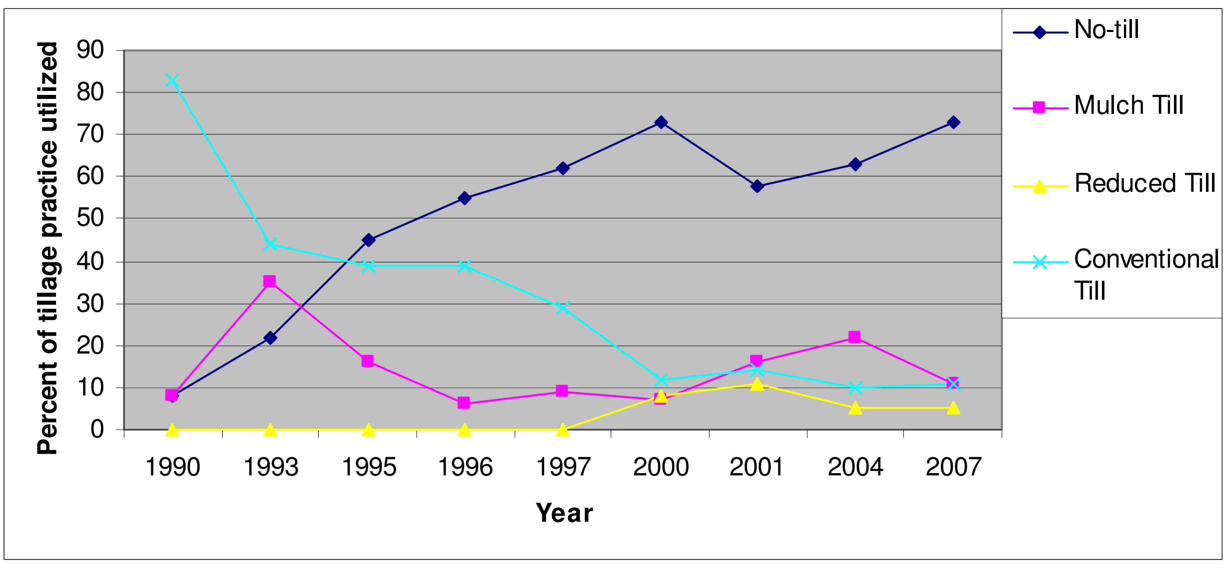
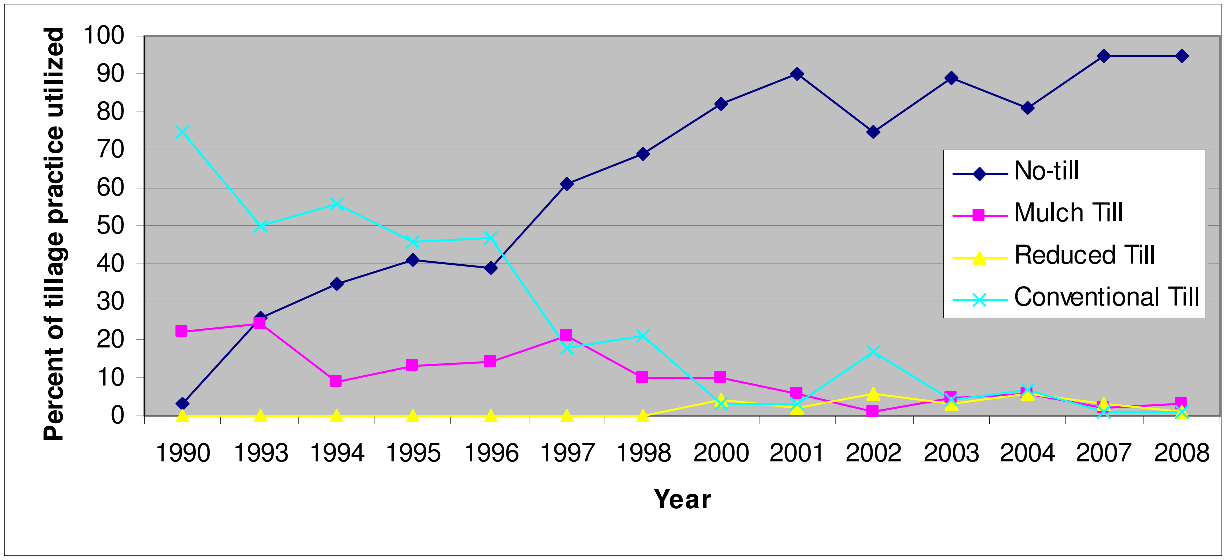


Figure 4.2.1-4 Shelby tillage practices for soybeans



Finally, local input has raised concerns about erosion and nutrient runoff. The local working group in Bartholomew County has prioritized gully erosion and nutrient runoff from tile drainage as problems in the county. The EQIP working group consisted of soil/water, wildlife, forestry, and farm professionals meeting to discuss priorities for the county. The working group ranking identified soil erosion as one of the top concerns, three (3) of the top five (5) concerns relate to soil erosion including gully erosion and sheet/rill. The group has ranked surface water-excessive nutrients (nitrate and phosphorus loading) as one of its top concerns for the past several years. Also, windshield survey observations conducted by the Flatrock-Haw Creek Watershed project include clearer water at headwaters in comparison to downstream, in-stream access by cattle, agricultural tiles draining into the stream, and large dump sites (mattresses, tires, and machinery).

4.2.2 Agricultural Practices: Livestock

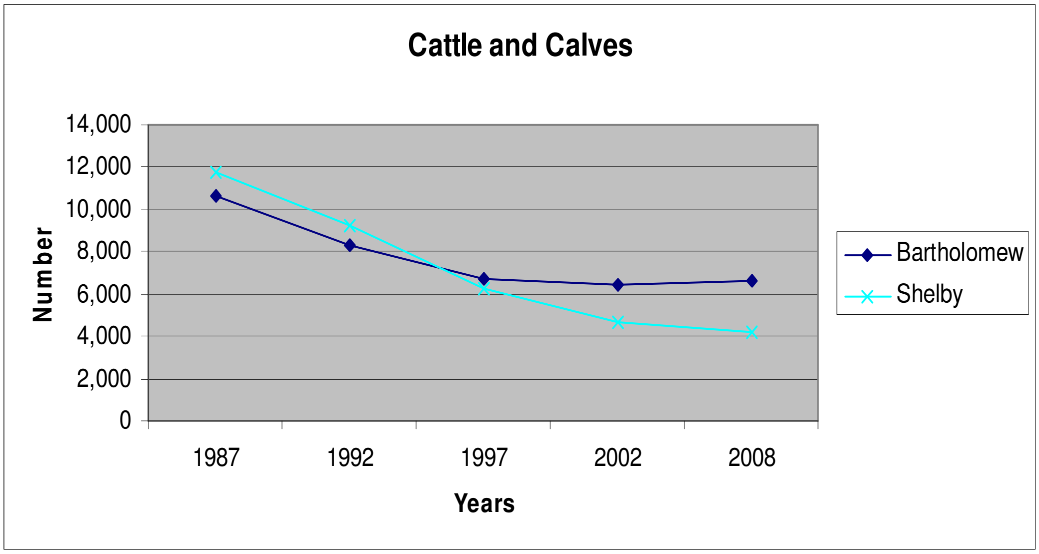
In addition to row crops there are a variety of livestock practices in the counties containing Flatrock-Haw Creek Watershed. Table 4.2.2 shows livestock types that are found in Bartholomew and Shelby counties. Figure 4.2.2 also shows how the livestock numbers have changed over time, most of the change is due to market prices. There are also areas in the watershed where livestock have unrestricted access to the stream, compounding existing water quality issues. Some BMPs that landowners can implement to help relieve these problems include fencing out the stream access to livestock and creating an alternative water source for the animals.

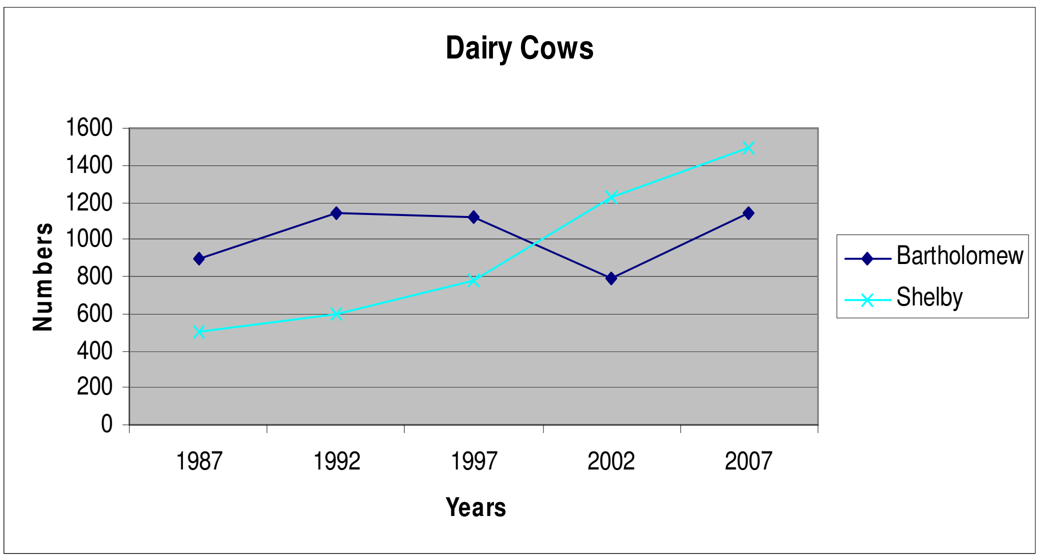
Table 4.2.2 Livestock type and numbers by county

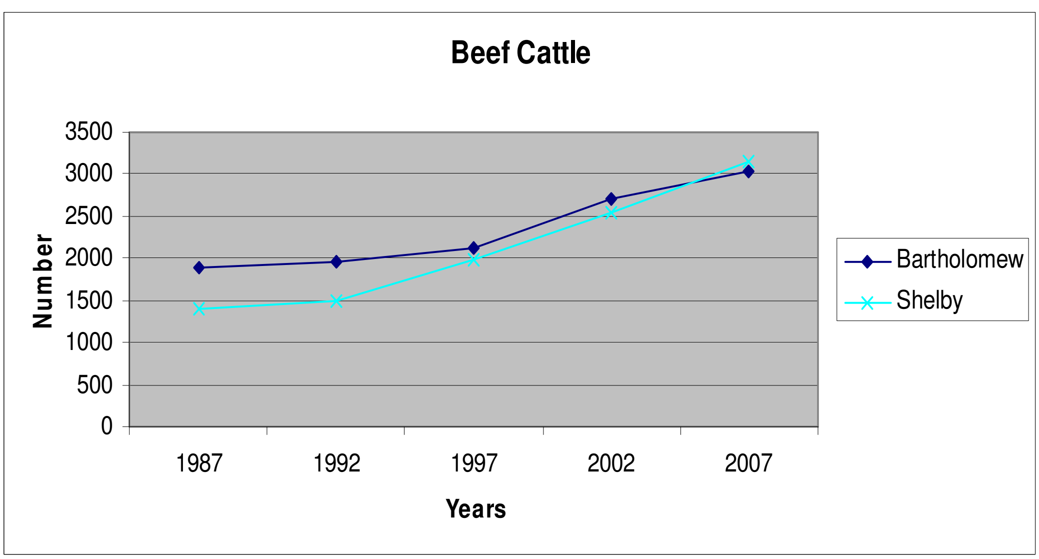
County	Livestock Type	Numbers
Bartholomew	Cattle and Calves	6,600
	Beef Cows	2,000
	Milk Cows	900
	Hogs and Pigs	16,746
	Sheep and Lambs	184
Shelby	Cattle and Calves	4,200
	Beef Cows	1,300
	Milk Cows	600
	Hogs and Pigs	34,108
	Sheep and Lambs	729

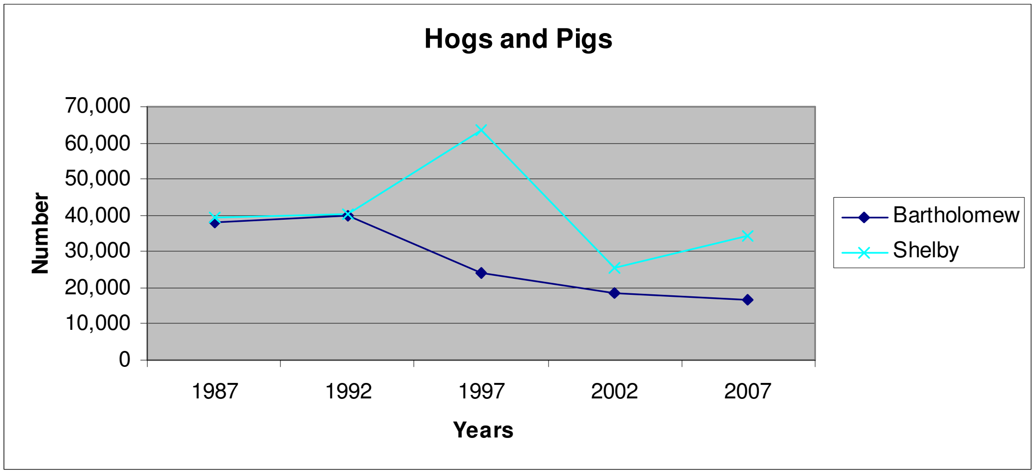
- 2007 for all animal numbers except cattle, 2008 for cattle

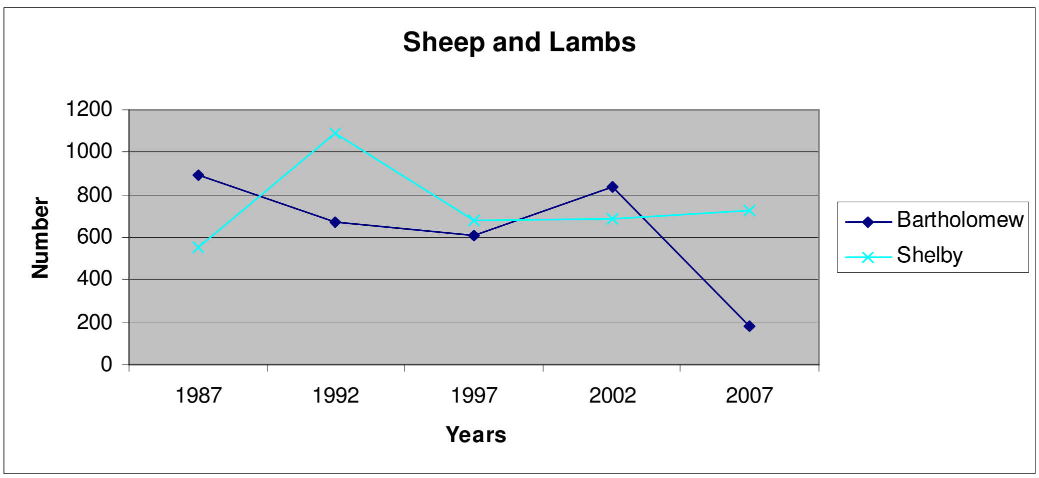
Figure 4.2.2 Livestock numbers by county and type over time







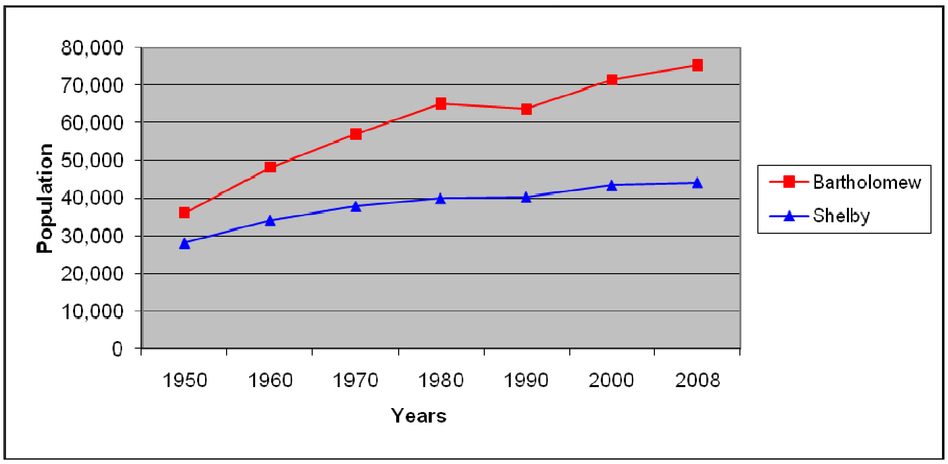

Hogs and Pigs
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Number
1987
1992
1997
2002
2007
Years
Bartholomew
Shelby


Sheep and Lambs
1200
1000
800
600
400
200
0
Number
1987
1992
1997
2002
2007
Years
Bartholomew
Shelby

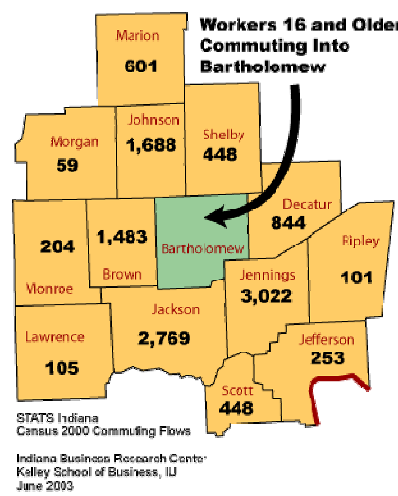
4.2.3 Urban/Suburban/Impervious Surface and Population Density

While Flatrock-Haw Creek Watershed is approximately 78% agricultural, there are a few main urban/suburban areas that may also influence water quality. Although 13.5% is listed as developed, only 6% of the land use is developed with low to high intensity (the other portion is developed open space). Developed open space is an area with less than twenty (20) percent impervious surfaces, mostly lawn grasses. Cities and towns in Flatrock-Haw Creek Watershed include Clifford, Columbus, Flatrock, Geneva, Hope, Old Saint Louis, Pleasure Valley, Saint Louis Crossing, and Taylorsville. Although the population growth in Columbus has been fairly consistent over the past fifty (50) years, the population that commutes into the Columbus area has steadily increased (Figure 4.2.3). In 2000, there were 12,334 people who lived outside Bartholomew County and commuted in for work in addition to the 30,010 Bartholomew County residents that work and reside in Bartholomew County.

Figure 4.2.3 Population change in Bartholomew and Shelby Counties



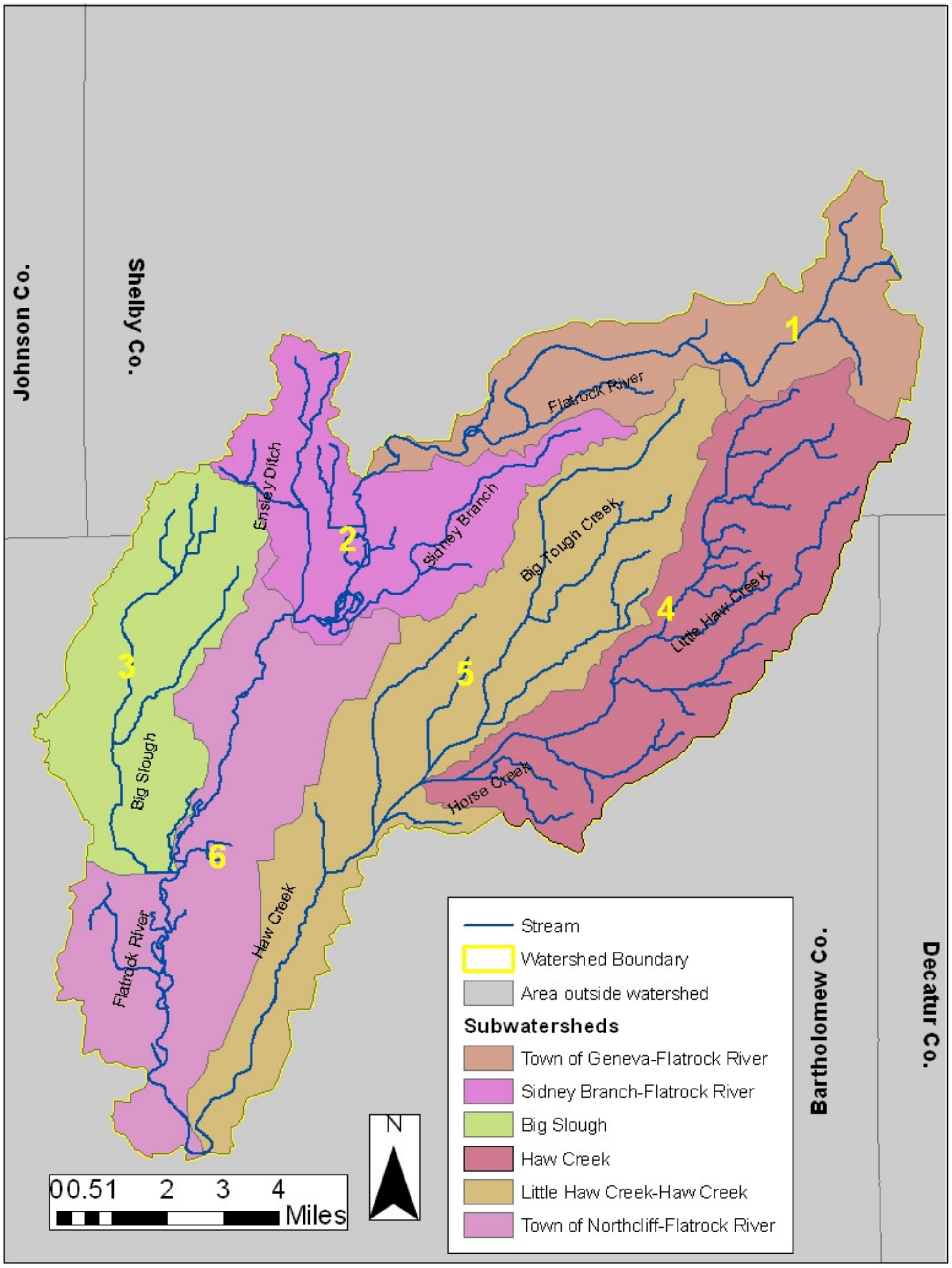
The Columbus commuting area includes Bartholomew, Brown, Decatur, Jackson, Jennings, Johnson, Lawrence, Monroe, Ripley, Scott and Shelby Counties (see below graphic)



4.3 Land Inventory and Spatial Research by Sub watershed

To help break up the watershed into more manageable areas the watershed has been divided into six (6) groups, the six (6) sub watersheds that make up the Flatrock-Haw Creek Watershed (Figure 4.3). Each section details the land use, population of any urban areas, number of confined feeding operations, and current and past water quality monitoring site locations in the sub watersheds.

Figure 4.3 Six sub watersheds in Flatrock-Haw Creek



4.3.1 Town of Geneva-Flatrock River (HUC 051202050601)

The Town of Geneva-Flatrock River sub watershed contains a portion of the Flatrock River as it first flows into Flatrock-Haw Creek Watershed (Figure 4.3.1). This sub watershed is the northern most area of Flatrock-Haw Creek Watershed and it is the only sub watershed completely in Shelby County. The majority of land use in this sub watershed is corn/soybean rotation agriculture, although most of the areas directly along the stream are forested. There is little urban land use within this sub watershed (Table 4.3.1). Geneva is a rural housing community, with a population of 1,368 that is located within the sub watershed boundary.

There are two (2) active confined feeding operations within this area (Figure 4.3.1). These two CFOs have a combined 1,504 nursery, sows and finisher swines. IDEM has two sites that have past general chemistry water quality data (Section 4.4.1). One site is on County Road 150W and was only sampled in 2002 but the other site (SR 252, near Flatrock) is a fixed site that has been monitored monthly since 1999 and is still in use. In addition there are two sites that were used in the 2002 Flatrock-Haw Creek Basin TMDL. These sites were on SR 9 and at the fixed station on SR 252 (Section 4.4.1). In addition to IDEM collected data there is one site that has been sampled by a Hoosier Riverwatch Volunteer (Flatrock camp, Section 4.4.1). The site at the Flatrock Camp is also being used for the current water quality monitoring.

Figure 4.3.1 Town of Geneva-Flatrock River in Flatrock-Haw Creek

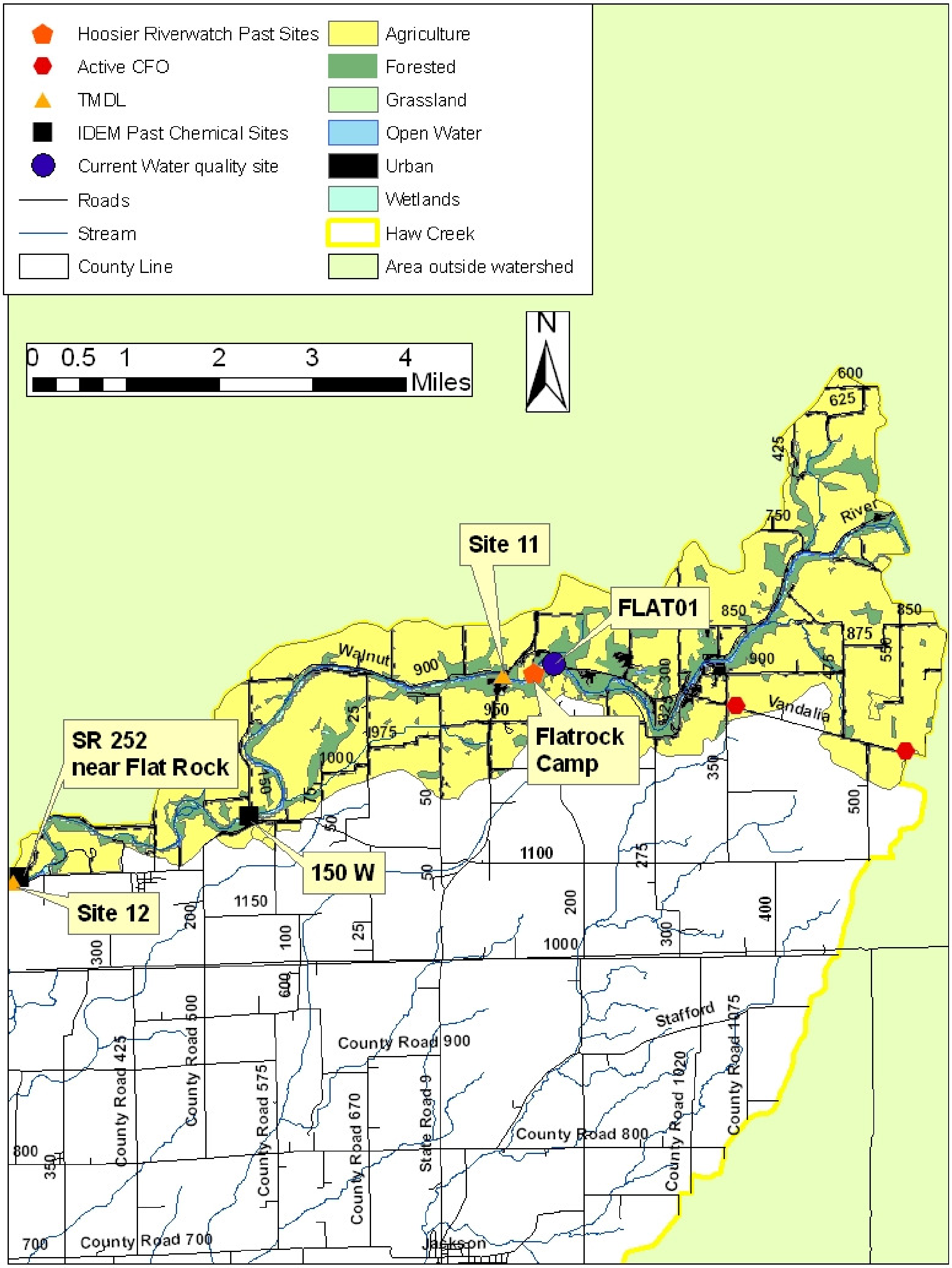


Table 4.3.1 Land use in Town of Geneva-Flatrock River

Land Use	% of Watershed
Water	0.37 %
Urban/Suburban/Developed open space	3.07 %
Forest	6.64 %
Grassland	0.05 %
Hay/Pasture	0.40 %
Row Crops	89.01 %
Wetlands	0.46 %

4.3.2 Sidney Branch-Flatrock River (HUC 051202050602)

Flatrock River continues through Sidney Branch-Flatrock River sub watershed. The confluence of Sidney Branch, Flatrock River and Ensley's Ditch is near the base of the sub watershed (Figure 4.3.2). The upper portion of the sub watershed is in Shelby County while the lower portion located in Bartholomew County. The majority of land use in this sub watershed is corn/soybean rotation agriculture. While the majority of the area along Flatrock River is forested the areas along Sidney Branch and Ensley's Ditch are corn/soybean rotation agriculture. There is also very little urban land use in Sidney Branch-Flatrock River (Table 4.3.2). Flat Rock, population 1,539, is the only residential concentration of houses in the sub watershed. There are no confined feeding operations within this area (Figure 4.3.2). General water quality data was collected six times in 1997 by IDEM just upstream of the watershed boundary. The current water quality monitoring site in this sub watershed is on Ensley's Ditch along county road 900 N.

Figure 4.3.2 Sidney Branch-Flatrock River in Flatrock-Haw Creek

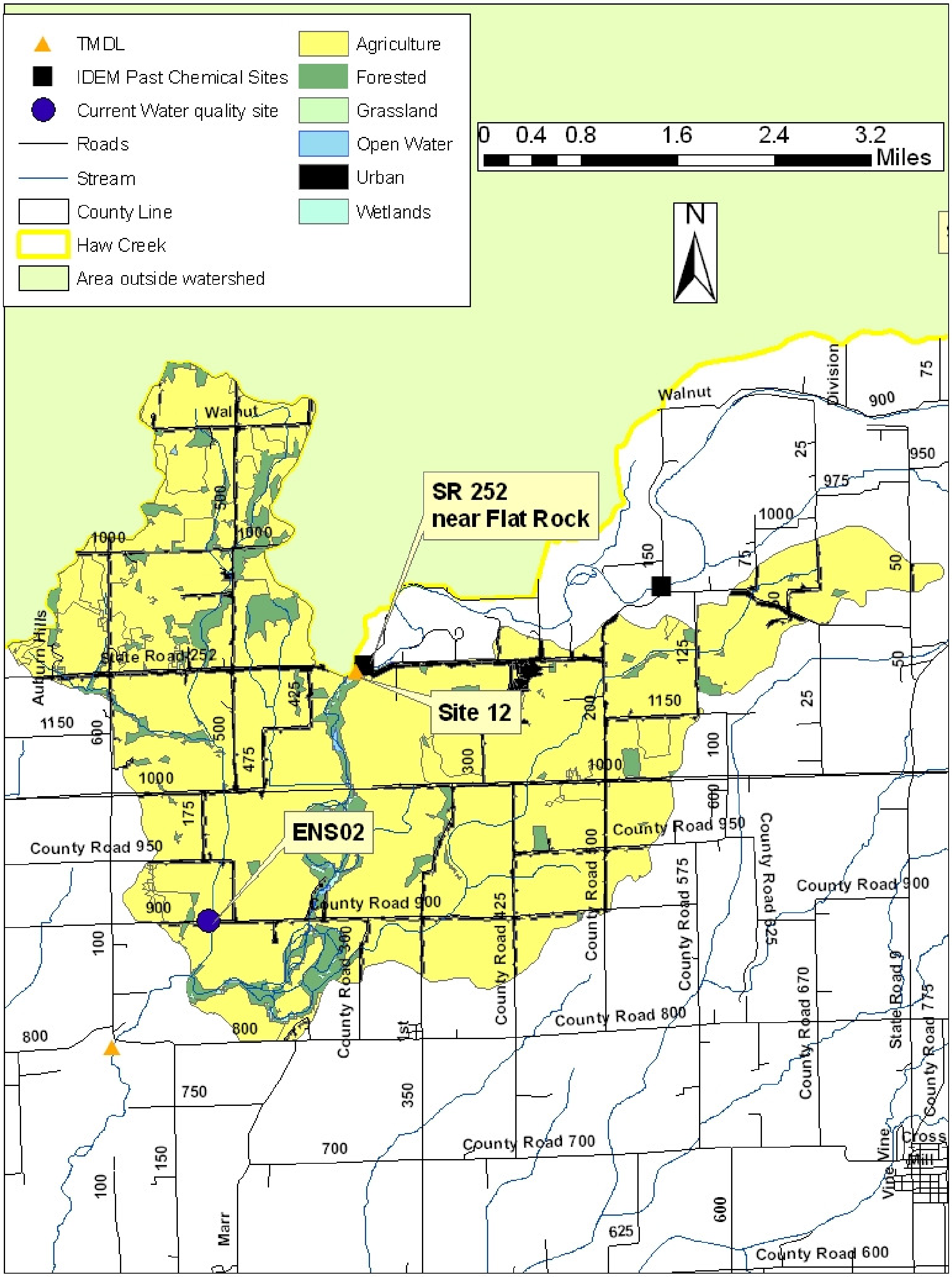


Table 4.3.2 Land use in Sidney Branch-Flatrock River

Land Use	% of Watershed
Water	0.08 %
Urban/Suburban/Developed open space	3.62 %
Forest	5.28 %
Grassland	0.04 %
Hay/Pasture	5.37 %
Row Crops	85.39 %
Wetlands	0.22 %

4.3.3 Big Slough (HUC 051202050603)

The Big Slough sub watershed contains the tributary of Big Slough, from its start until it confluences with Flatrock River at the base of the sub watershed (Figure 4.3.3). A small portion of the sub watershed is in Shelby County, with the majority of the area in Bartholomew County. The majority of land use in this sub watershed is corn/soybean rotation agriculture. Urban land use makes up the next largest land use classification (Table 4.3.3), as it contains portions of Columbus (population 39,690) and Taylorsville (population 942). There is one (1) active concentrated animal feeding operation within this area (Figure 4.3.3). This CAFO has 2,760 finisher swine. The water monitoring site in this sub watershed is dry for a majority of the year and will only be used for sampling larger storm events. There are no sites within this area where water quality has been tested prior to this project; most likely due to the lack of flow in the major water body in this sub watershed. Currently, the project has a water monitoring site that is used to collect storm event runoff.

Figure 4.3.3 Big Slough in Flatrock-Haw Creek

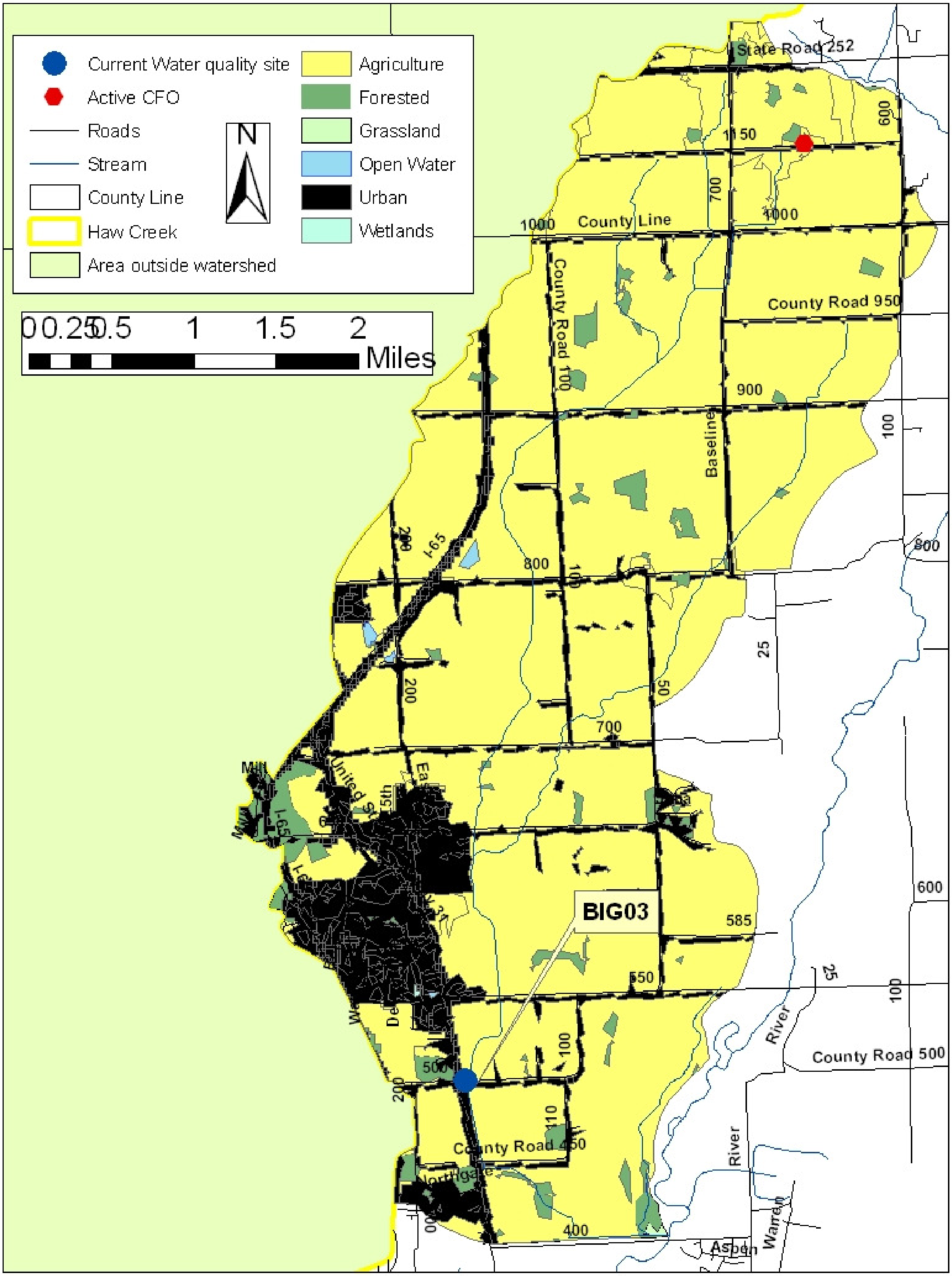


Table 4.3.3 Land use in Big Slough

Land Use	% of Watershed
Water	0.11 %
Urban/Suburban/Developed open space	12.49 %
Forest	3.79 %
Grassland	0.05 %
Hay/Pasture	3.25 %
Row Crops	80.30 %
Wetlands	0.01 %

4.3.4 Haw Creek (HUC 051202050604)

The Haw Creek sub watershed contains a portion of the headwaters of Haw Creek; including the tributaries of Little Haw Creek, Horse Creek, and Chickens Creek (Figure 4.3.4). The upper portion of the sub watershed is in Shelby County with the remainder in Bartholomew County. The majority of land use in this sub watershed is corn/soybean rotation agriculture, with some forested areas directly along the stream. There is also minor urban land use in Haw Creek, although it does contain the town of Hope (population 2,140) (Table 4.3.4). The largest number of confined feeding operations is located in this sub watershed. There are six (6) active confined feeding operations and three (3) concentrated animal feeding operations within the area (Figure 4.3.4). The active CFOs consist of 18,040 nursery, sow, and finisher hogs and 330 dairy cattle and calves. The three CAFOs consist of 11,290 nursery, sow, and finisher hogs. In addition to the regulated CFOs, there is the Hope Waste Water Treatment Plant (WWTP), and a wood products area that is NPDES regulated. IDEM and Hoosier Riverwatch do not currently have any sampling sites within this area so no past water quality data exists for the water bodies. Water monitoring is occurring currently at a site near the bottom of the sub watershed along county road 450 N.

Figure 4.3.4 Haw Creek in Flatrock-Haw Creek

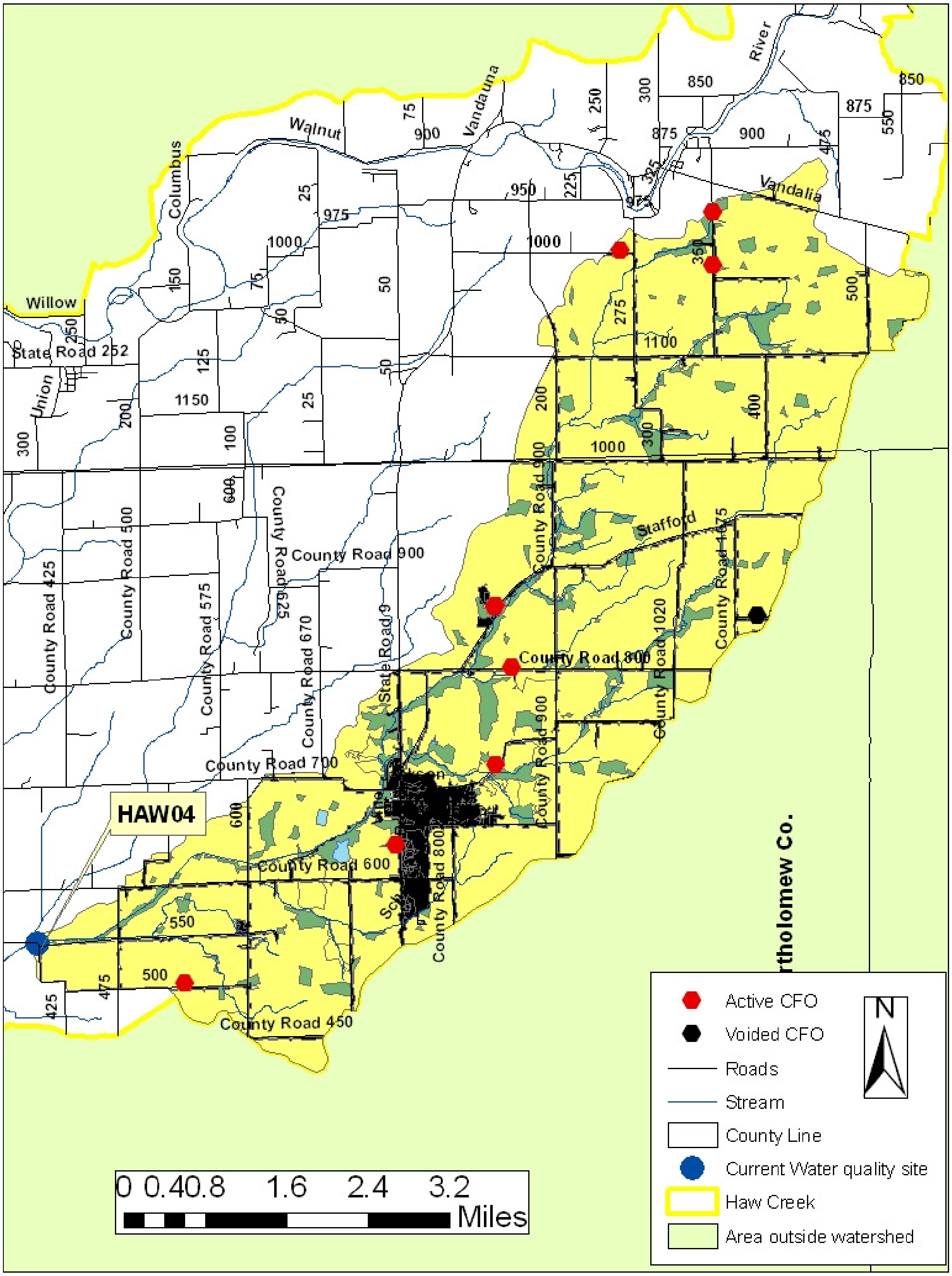


Table 4.3.4 Land use in Haw Creek

Land Use	% of Watershed
Water	0.11 %
Urban/Suburban/Developed open space	4.29 %
Forest	4.49 %
Grassland	0.02 %
Hay/Pasture	1.27 %
Row Crops	89.82 %
Wetlands	0.00 %

4.3.5 Little Haw Creek-Haw Creek (HUC 051202050605)

The Little Haw Creek-Haw Creek sub watershed contains the lower portion of Flatrock-Haw Creek along with several tributaries. These tributaries include Slash Loesch Ditch, Tough Creek, and Chambers Ditch (Figure 4.3.5). This sub watershed stretches nearly the length of Flatrock-Haw Creek Watershed, with the majority of it in Bartholomew County. At the base of this sub watershed is the location where Haw Creek flows into the East Fork of the White River. The majority of land use in this sub watershed is corn/soybean rotation agriculture, with very little of the areas directly along the stream forested. Urban land use make up the next largest portion, as it includes a large portion of Columbus (Table 4.3.5). There are two (2) confined feeding operations within this area (Figure 4.3.5). The two active CFOs have a total of 4,846 nursery, sow, and finisher hogs. Other regulated facilities include Cross Cliff Elementary and Cummins, Inc which are both NPDES regulated. These operations are all in the upper portions of the sub watershed, two in each county. IDEM has one site (SR 7) that has past general chemistry water quality data (Section 4.4.1). In addition this site was used in the 2002 Flatrock-Haw Creek Basin TMDL. There are two current water monitoring sites in this sub watershed. One is in the upper portion of the sub watershed along 450 N and one is near the bottom of the sub watershed along State Street in Columbus.

Figure 4.3.5 Little Haw Creek-Haw Creek in Flatrock-Haw Creek

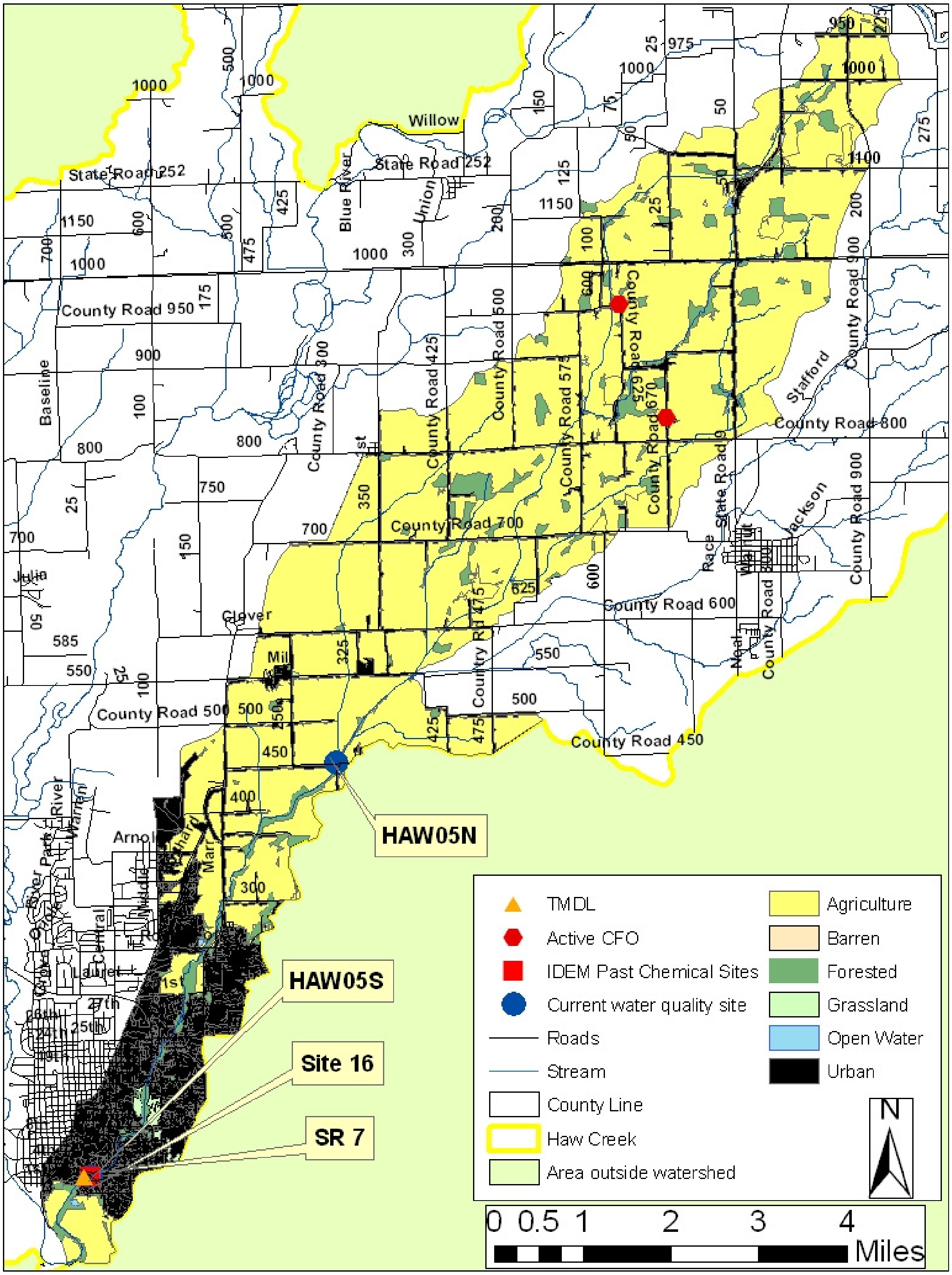


Table 4.3.5 Land use in Little Haw Creek-Haw Creek

Land Use	% of Watershed
Water	0.27 %
Urban/Suburban/Developed open space	12.65 %
Barren	0.002
Forest	3.47 %
Grassland	0.21 %
Hay/Pasture	0.96 %
Row Crops	82.44 %
Wetlands	0.00 %

4.3.6 Town of Northcliff-Flatrock River (HUC 051202050606)

The Town of Northcliff-Flatrock River sub watershed contains the lower portion of Flatrock River (Figure 4.3.6). Near the base of this area is where Flatrock River flows into the East Fork of the White River. This is the only sub watershed completely located within Bartholomew County. While the majority of land use in this sub watershed is row crop agriculture it has the lowest amount of corn/soybean rotation land use of any sub watershed. This area also has the highest urban land use of all the sub watersheds, as it contains a large portion of Columbus (Table 4.3.6). There are no confined feeding operations within this area (Figure 4.3.6). NPDES regulated facilities include Columbus WWTP's multiple outlets and a groundwater petroleum remediation site. While there is no plan for the project to monitor in this sub watershed data can be obtained from IDEM who has a fixed site near the base of the sub watershed. This site is one of three sites where general water chemistry has been monitored in the past (800N, SR 11, and SR 46 fixed station) (Section 4.4.1). There are also two sites that are monitored occasionally by Hoosier Riverwatch volunteer student groups (Mill Race and Noblitt Parks).

Figure 4.3.6 Town of Northcliff-Flatrock River in Flatrock-Haw Creek

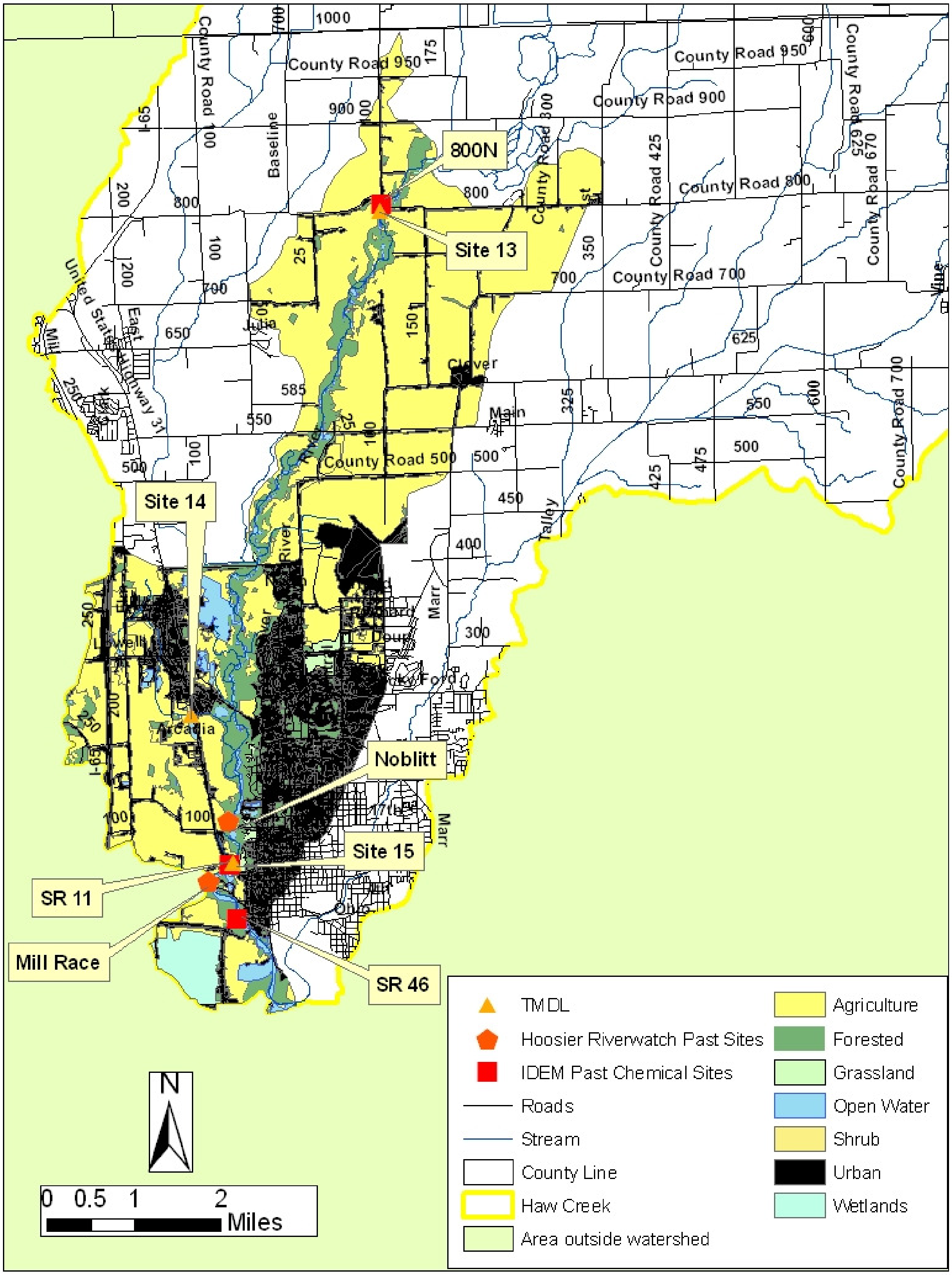


Table 4.3.6 Land use in Town of Northcliff-Flatrock River

Land Use	**% of Watershed**
Water	1.64 %
Urban/Suburban/Developed open space	16.02 %
Forest	6.13 %
Shrub	0.01 %
Grassland	0.41 %
Hay/Pasture	1.39 %
Row Crops	74.35 %
Wetlands	0.05 %

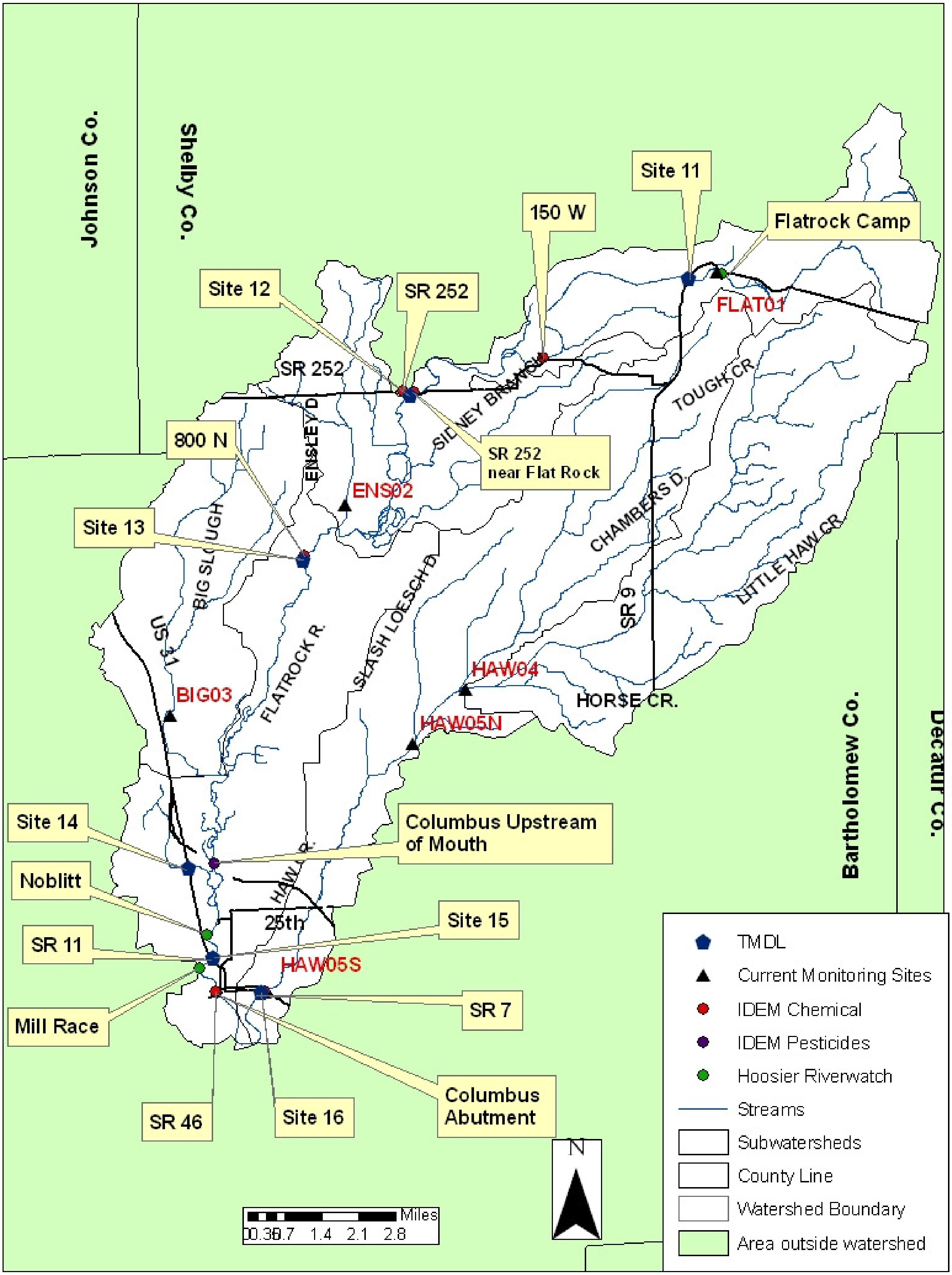
4.4 Existing Data and Current Water Quality Sampling

Indiana Department of Environmental Management (IDEM), Hoosier Riverwatch volunteers, and Flatrock-Haw Creek Watershed Project volunteers have collected water quality data within the watershed area. Figure 4.4 shows past data sites from IDEM, past Hoosier Riverwatch volunteer sites, and Flatrock-Haw Creek current water monitoring sites. Data monitored at these sites included chemical, biological, habitat, and flow data (Table 4.4). Chemical data includes parameters such as pH, nitrates/phosphates, and dissolved oxygen etc. Biological sampling includes parameters such as macroinvertebrates, fishing, etc. Habitat sampling includes the Citizens Qualitative Habitat Evaluation Index (CQHEI). Flow includes parameters to measure discharge or stream velocity. Volunteer monitors began collecting samples at five sites in May 2009. Data collected from these sites include stream flow, general water chemistry, habitat and biological data. The collection and analysis conducted on a monthly basis in accordance with the Flatrock-Haw Creek Watershed Quality Assurance Project Plan (QAPP). Biological sampling occurs twice yearly in May and August. Data collection incorporates Hoosier Riverwatch methods for in-field sampling and laboratory analysis done by Columbus City Utilities laboratory.

Table 4.4 Sampling Types for various organizations within Flatrock-Haw Creek Watershed

Organization	Sampling Types			
	Chemical	Biological	Habitat	Flow
IDEM	X	X		
Hoosier Riverwatch	X	X	X	X
FRHC	X	X	X	X

Figure 4.4 Past and current monitoring sites in Flatrock-Haw Creek Watershed



4.4.1 Chemical and Pathogen Data

For most of the parameters that are potential concerns in the watershed IDEM either has standards or target limits that should be met to ensure adequate water quality to support the area uses (drinking and water recreation). These standards/targets can be seen in Table 4.4.1-1. Also, Table 4.4.1-1 shows the general water chemistry data that IDEM has collected at seven (7) sites throughout the watershed.

Table 4.4.1-1 Standard or target levels for contaminants

Parameter	Standard/Target	Source
E.coli	235 cfu /100 mL single sample max, Geometric Mean of 125 cfu/100 ml from 5 equally spaced samples over 30 days	State Standard, Indiana Administrative Code
Nitrate + Nitrite	< 10 mg/L	State Standard, Indiana Administrative Code
Ammonia	< 0.21 mg/L	State Standard, Indiana Administrative Code
Total Phosphorus (TP)	< 0.30 mg/L	IDEM Draft TMDL Target
Total Suspended Solids (TSS)	< 30 mg/L	IDEM Draft TMDL Target

Table 4.4.1-2 shows general chemistry for several sites sampled by IDEM. Table 4.4.1-3 focuses on E. coli data from the 2002 TMDL. The sites listed below in the table are the ones that fall within the watershed. The TMDL completed in 2002 by IDEM highlights the need for improvement of water bodies in the Flatrock-Haw Creek Basin. In the larger basin there were six (6) sites tested for E. coli that fall within the smaller Flatrock-Haw Creek Watershed. These samples showed spikes over 2400 cfu/100 mL and geometric means above the state standard for primary contact at all but one (1) site.

Table 4.4.1-2 Summary data for selected parameters, IDEM

Location	IDEM Site Type	# of Samples	Parameter	Median	Max.	Min.	# of times above standard or target	Year(s) above standard or target
CR 150 W (2002) (HUC: 051202050601)	Probabilistic	3	Ammonia (mg/L)	< 0.10	< 0.10	< 0.10	0	NA
		3	Nitrate + Nitrite (mg/L)	2.70	6.00	0.08	0	NA
		3	Total Phosphorus (mg/L)	0.08	0.12	0.06	0	NA
		3	TSS (mg/L)	11.00	19.00	8.00	0	NA
CR 800 N (2002) (HUC: 051202050606)	Probabilistic	3	Ammonia (mg/L)	< 0.10	< 0.10	< 0.10	0	NA
		3	Nitrate + Nitrite (mg/L)	2.50	3.50	1.20	0	NA
		3	Total Phosphorus (mg/L)	0.07	0.07	0.03	0	NA
		3	TSS (mg/L)	14.00	20.00	5.00	0	NA
SR 11 (1997 and 2002) (HUC: 051202050606)	Probabilistic	7	Nitrate + Nitrite (mg/L)	4.30	7.10	1.80	0	NA
		7	Total Phosphorus (mg/L)	0.12**	0.31**	0.04	1	2002
		7	TSS (mg/L)	26.00	109.00 **	4.00	3	1997-2002
		3	E. coli (CFU/100 mL)	120.00	1800.0 0*	90.00	1	1997
SR 252 (1997) (HUC: 051202050602)	Probabilistic	6	Nitrate + Nitrite (mg/L)	3.95	5.80	1.90	0	NA
		6	Total Phosphorus (mg/L)	0.05	0.07	0.04	0	NA
		6	TSS (mg/L)	9.00	29.00	4.00	0	NA
		3	E. coli (CFU/100 mL)	310.00*	600.00 *	130.00	2	1997
SR 252, near Flat Rock (1999-2008) (HUC: 051202050601)	Fixed	114	Ammonia (mg/L)	< 0.10	< 0.10	< 0.10	0	NA
		114	Nitrate + Nitrite (mg/L)	4.47	11.00*	0.10	2	2001, 2008
		114	Total Phosphorus (mg/L)	0.05	0.51**	0.03	4	2006
		114	TSS (mg/L)	9.00	280.00 **	4.00	17	2000-2008

Location	IDEM Site Type	# of Samples	Parameter	Median	Max.	Min.	# of times above standard or target	Year(s) above standard or target
SR 46 (1991-2008) (HUC: 051202050606)	Fixed	211	Ammonia (mg/L)	0.10	0.30*	< 0.10	2	1994
		218	Nitrate + Nitrite (mg/L)	3.20	6.60	1.00	0	NA
		218	Total Phosphorus (mg/L)	0.08	0.52**	0.03	3	1994-1998
		217	TSS (mg/L)	13.00	408.00 **	4.00	45	1991-2008
		89	E. coli (1991-1998) (CFU/100 mL)	100.00	5000.00*	10.00	29	1991-1998
SR 7 (1997) (HUC: 051202050605)	Probabilistic	6	Nitrate + Nitrite (mg/L)	2.80	4.40	0.67	0	NA
		6	Total Phosphorus (mg/L)	0.07	0.09	0.03	0	NA
		6	TSS (mg/L)	4.00	10.00	4.00	0	NA
		3	E. coli (CFU/100 mL)	100.00	180.00	30.00	0	NA

* Values that exceed Indiana Administrative Code Standards for that parameter
** Values that exceed the IDEM Draft TMDL Target (http://www.in.gov/idem/6242.htm

Table 4.4.1-3 E. coli data from 2002 TMDL sites in smaller Flatrock-Haw Creek Watershed, IDEM

Site ID	Description	Sample Date	E. coli (CFU/100 mL)	Geometric Mean (CFU/100 ml)
WEF050-0013, Site 11	SR 9, Flatrock River, Shelby County (HUC: 051202050601)	5/30/2002	310*	--
		6/6/2002	> 2400*	
		6/13/2002	78	
		6/20/2002	50	
WEF050-0002, Site 12	SR 252 fixed station, Flatrock River, Shelby County (HUC: 051202050601)	6/16/2000	830*	
		7/27/2000	120	
		5/31/2001	200	
		5/30/2002	340*	634*
		6/6/2002	1700*	
		6/13/2002	820*	
		6/20/2002	240*	
		6/27/2002	440*	
		9/16/2002	153	--
		9/23/2002	48.8	
		9/30/2002	54.6	
		10/7/2002	52	
		6/23/2004	290*	
		9/30/2004	93	
WEF050-009, Site 13	CR 800 N, Flatrock River, Bartholomew County (HUC: 051202050606)	5/30/2002	550*	438*
		6/6/2002	1600*	
		6/13/2002	460*	
		6/20/2002	87	
		6/27/2002	460*	
WEF050-0001, Site 14	SR 31 USGS gage, Flatrock River, Bartholomew County (HUC: 051202050606)	5/30/2002	580*	--
		6/6/2002	340*	
		6/13/2002	210	
		6/20/2002	17	
WEF050-004, Site 15	SR 11, Flatrock River, Bartholomew County (HUC: 051202050606)	5/30/2002	730*	615*
		6/6/2002	550*	
		6/13/2002	1300*	
		6/20/2002	70	
		6/27/2002	> 2400*	
WEF060-002, Site 16	SR 7 Columbus, Haw Creek, Bartholomew County (HUC: 051202050605)	7/31/2002	275*	234*
		8/7/2002	86	
		8/15/2002	866*	
		8/21/2002	228	
		8/28/2002	150	
* Values that exceed Indiana Administrative Code standards -E.coli standards are <235 cfu/100 ml for single samples and <125 cfu/100 mL for geometric means.				

There are three (3) sites where data has been collected by other Hoosier Riverwatch volunteers prior to the beginning of this project's inception. This data has been collected at various times between 1997 and 2008. Table 4.4.1-5 shows this general water chemistry data as well as the number of samples taken at each site.

Table 4.4.1-5 Summary data for selected parameters, Hoosier Riverwatch

Location	**Sample Number**	**Parameter**	**Median**	**Maximum**	**Minimum**	**# of times over standard or target**	**Year(s)**
Flatrock camp (2001-2002) (HUC: 051202050601)	1	E. coli (CFU/100 mL)	0.00	0.00	0.00	0	NA
	3	pH	8.50	8.50	8.40	0	NA
	1	BOD5 (mg/L)	4.00	4.00	4.00	0	NA
	4	Water Temp.(C)	11.00	20.00	1.00	0	NA
	4	Turbidity (NTU)	9.00	40.00**	5.00	1	2001
Near Mill Race Park, Columbus (2001-2003) (HUC: 051202050606)	10	Dissolved Oxygen (mg/L)	11.18	13.67*	7.30	3	2000-2001
	2	E. coli (CFU/100 mL)	100.00	100.00	100.00	0	NA
	1	General. Coliforms (CFU/100 mL)	10.00	10.00	10.00	0	NA
	10	pH	7.96	9.73	7.40	0	NA
	10	BOD5 (mg/L)	2.85	4.33	0.30	0	NA
	10	Water Temp.(C)	13.50	26.00	5.00	0	NA
	10	Turbidity (NTU)	12.00**	18.00**	5.00	0	NA
Noblitt Park, Columbus (1997-2008) (HUC: 051202050606)	35	Dissolved Oxygen (mg/L)	9.60	12.67*	7.00	1	2004
	20	E. coli (CFU/100 mL)	42.00	13333.00*	0.00	2	2007-2008
	17	G. Coliforms (CFU/100 mL)	1889.00	53334.00	10	0	NA
	35	pH	7.90	9.37	6.67	0	NA
	35	BOD5 (mg/L)	1.00	7.00	0.00	0	NA
	35	Water Temp.(C)	16.00	22.00	6.00	0	NA
	35	Turbidity (NTU)	15.01**	90.00**	5.00	3	2003-2008

* Values that exceed Indiana Administrative Code standards for that parameter- E.coli standard are <235 cfu/100 mL Dissolved Oxygen standards are 4-12 mg/L.
** Values that exceed US EPA recommendation. Turbidity targets are < 10.4 NTU (http://www.in.gov/idem/6242.htm)

Table 4.4.1-6 shows the current project data for selected parameters. Some of the parameters that have not been included are turbidity, dissolved oxygen (DO), and BOD. DO and BOD were not shown since all samples have been within an acceptable limit. The limit for DO is between 4 and 12 mg/L and for BOD anything below 5 mg/L indicates fairly clean water in regards to organic waste.

Table 4.4.1-6 Summary Data for selected parameters, 2009-2010 Project Data

Location	Sample Number	Parameter	Median	Maximum	Minimum	# of times over standard or target
BIG03	7	Nitrate-N (mg/L)	7.77	10.5*	4.59	1
	7	Ammonia-N (mg/L)	0.06	0.09	0.03	0
(HUC:	7	Total Phosphorus (mg/L)	0.06	0.09	0.05	0
051202050603)	2	Turbidity (NTU)	15 ***	15.00*	<15	1
ENS02	18	E.coli (cfu/100 mL)	375*	14500*	0	11
	20	Nitrate-N (mg/L)	7.97	12.60*	0.02	2
(HUC:	20	Ammonia-N (mg/L)	0.03	0.2	0.02	0
051202050602)	20	Total Phosphorus (mg/L)	0.04	1.45**	0	1
	21	Turbidity (NTU)	<15	95**	<15	3
FLAT01	18	E.coli (cfu/100 mL)	0	5450*	0	5
	17	Nitrate-N (mg/L)	4.99	7.57	0.10	0
(HUC:	17	Ammonia-N (mg/L)	0.05	0.14	0.02	0
051202050601)	17	Total Phosphorus (mg/L)	0.08	0.96**	0.01	2
	20	Turbidity (NTU)	15 ***	84.60**	<15	18
HAW04	17	E.coli (cfu/100 mL)	200	8900*	0	7
	19	Nitrate-N (mg/L)	5.35	10.50*	0.17	1
(HUC:	19	Ammonia-N (mg/L)	0.04	0.32*	0.02	1
051202050604)	19	Total Phosphorus (mg/L)	0.12	1.42**	0.04	3
	20	Turbidity (NTU)	<15	88**	<15	6
HAW05N	12	E.coli (cfu/100 mL)	550*	10000*	0	8
	14	Nitrate-N (mg/L)	5.60	7.61	0.02	0
(HUC:	14	Ammonia-N (mg/L)	0.03	0.06	0.02	0
051202050605)	14	Total Phosphorus (mg/L)	0.09	0.32**	0.03	1
	16	Turbidity (NTU)	15 ***	22**	<15	11
HAW05S	10	E.coli (cfu/100 mL)	633*	6500*	0	6
	11	Nitrate-N (mg/L)	5.00	7.06	0.02	0
(HUC:	11	Ammonia-N (mg/L)	0.03	0.06	0.01	0
051202050605)	11	Total Phosphorus (mg/L)	0.08	0.3**	0.05	1
	13	Turbidity (NTU)	<15	21.90**	<15	5

*Values that exceed Indiana Administrative Code standards for that parameter. E.coli standard is <235 cfu/100 mL, Nitrate-N standard is less than 10 mg/L.
** Values that exceed IDEM draft TMDL target. Ammonia standards, which are dependent on both pH and temperature, is approximately <0.21 mg/L. Total phosphorus targets are <0.30 mg/L.
*** Turbidity target is <10.4 NTU (Hoosier Riverwatch detection methods doesn't measure below 15 NTU)

There has been a variety of data collected since 1991 at the lower end of the watershed and throughout the watershed since 1997. While much of the data has been shown to be below the standard or targets set by IDEM and USEPA, there have been several occurrences where single samples have been above those limits. For Nitrate + Nitrite IDEM has only had one site that has shown values above the drinking water standard, and those two occurrences were just above the standard at 11 mg/L. Data collected since May 2009 has not shown any values over the drinking water standard. IDEM data has shown three of the seven chemical monitoring sites exceeding the target for total phosphorus. The project data has also seen three of its six monitoring sites exceed the target limit. Ammonia has shown to be only a slight problem. IDEM only had one site exceed the target, and as previously stated the target is an approximation since ammonia is pH and temperature dependent. The largest problem noted in the watershed is E.coli. IDEM data has one site that has exceeded the safe primary contact limit of 235 cfu/mL 29 times since 1991. The project data has shown multiple samples exceeding the standard at all of the sites where E.coli is monitored. In addition, the past Hoosier Riverwatch data has shown levels exceeding the standard with one spike level at 13,333 cfu/100 mL. Finally, IDEM data has shown three sites that are above the target for TSS, including the two fixed sites. The fixed site at 252 near Flat Rock has had seventeen samples and the site at State Road 46 has had forty-five samples that are above the target limit. The State Road 46 site is on the East Fork of the White River after the Flatrock and Driftwood Rivers come together.

4.4.2 Physical Data and Stream Habitat

Another indication of a good stream is adequate habitat for the fish and macroinvertebrates that occupy the water body. There are three (3) sites that have been analyzed for habitat by Hoosier Riverwatch volunteers (Table 4.4.2-1). A score over 100 is considered a high quality stream for habitat although anything above 60 is said to be conducive to warmwater fauna existence. As can be seen in Table 4.4.2-2, only 2 of the sites have a habitat score high enough to be classified as conducive to warmwater fauna existence. The other four sites are below this threshold and are in need of restoration to improve fish and macroinvertebrate habitat.

Table 4.4.2-1 Citizens Qualitative Habitat Evaluation Index (CQHEI) averages for Flatrock-Haw Creek, Hoosier Riverwatch

Site	Average CQHEI Score
Flatrock River, behind 240 acre camp (2001-2002)	90.75
Near Mill Race Park, Columbus (2000-2003)	71.83
Noblitt Park, Columbus (2001-2008)	78.34

Table 4.4.2-2 Citizens Qualitative Habitat Evaluation Index (CQHEI) averages for current project data

Site	Average CQHEI Score
FLAT01	85.36
ENS02	30.67
BIG03	26.00
HAW04	42.40
HAW05N	67.75
HAW05S	49.00

4.4.3 Biological Communities

In addition to water chemistry, conclusions can be drawn by the type/abundance of fish and macroinvertebrates found in a stream. There are four sites that were sampled by IDEM for fish community studies. Three sites were on Flatrock River and one was on Haw Creek (Table 4.4.3-1). There are three (3) sites where macroinvertebrates have been collected in the Flatrock-Haw Creek Watershed by Hoosier Riverwatch non-project volunteers (Table 4.4.3-2). Also, the watershed project has conducted macroinvertebrate sampling at five sites. (Table 4.4.4-3) A score above 23 is rated as excellent and anything between 17 and 22 is rated as good. The large flood in June 2008 in the watershed may have had a severe impact on macroinvertebrate populations. While this needs to be investigated further with sampling after the flood, the change in substrate and overall stream habitat could have an impact on the number and type of species found at these sites.

Table 4.4.3-1 Index of Biotic Integrity

Site	Year	Species found	Index of Biotic Integrity (IBI) Score	Predominant fish species
Flatrock River, 150W, Shelby County	2002	29	56 (Excellent)	Bigeye chub, black redhorse, bluntnose minnow, golden redhorse, greenside darter, lonear sunfish, spotfin shiner
Flatrock River, 800N, Bartholomew County	2002	32	52 (Good)	Bigeye chub, bluntnose minnow, central stoneroller, longear sunfish, sand shiner, and spotfin shiner
Haw Creek, 690N, Bartholomew County	1997	11	32 (Poor)	Bluntnose minnow, creek chub, green sunfish, johnny darter, orange throat darter
Flatrock River, 850S, Shelby County	1997	16	32 (Poor)	Bluntnose minnow, longear sunfish, bluegill

Table 4.4.3-2 Pollution Tolerance Index (PTI) averages for Flatrock-Haw Creek, Hoosier Riverwatch

Site	**Average PTI Score**	**Rating**
Flatrock River, behind 240 acre camp (2001-2002)	37.50	Excellent
Near Mill Race Park, Columbus (2000-2003)	18.80	Good
Noblitt Park, Columbus (2001-2008)	17.40	Good

Table 4.4.4-3 Pollution Tolerance Index (PTI) averages for current project data

Site	**Average PTI Score**	**Rating**
FLAT01	27.75	Excellent
ENS02	10.00	Poor
BIG03	0.00	Poor
HAW04	6.00	Poor
HAW05N	10.50	Poor
HAW05S	7.50	Poor

5.0 Problem Statements, Prioritization, and Goals Development

Using the information gathered from water quality data, public meetings, windshield surveys, and technical meetings the steering committee acknowledge that nutrients, E. coli, and sediment are the contaminants that are decreasing water quality in the watershed. Other concerns included trash & debris along the banks, other contaminants (such as oil, salt, etc.), and the need to improve recreation by improving stream habitat. An additional concern that indirectly leads to poor water quality is the lack of education about water quality issues in the local community. Finally, a concern was also listed for the rate of water leaving Flatrock-Haw Creek Watershed and the impact that has on stream bank and in-stream erosion.

5.1 Local Concerns

Near the beginning of the planning process the project held a public meeting where local stakeholders could come and voice their opinions on the water quality issues that are important to them. Stakeholders were given the following list of concerns and could add additional ones under the 'Other' section (Appendix C). They were asked to rank them on a 1 to 5 scale, with 1 as their highest priority and 5 as their lowest. The ranks were then averaged to get the values seen in Table 5.1. The steering committee agreed with the concerns and added the rate of water leaving Flatrock-Haw Creek, the lack of pervious surfaces in Columbus which can increase flooding, and maintaining/improving recreation (fishing, swimming, etc.).

Table 5.1 Concerns identified at the public meeting and steering committee

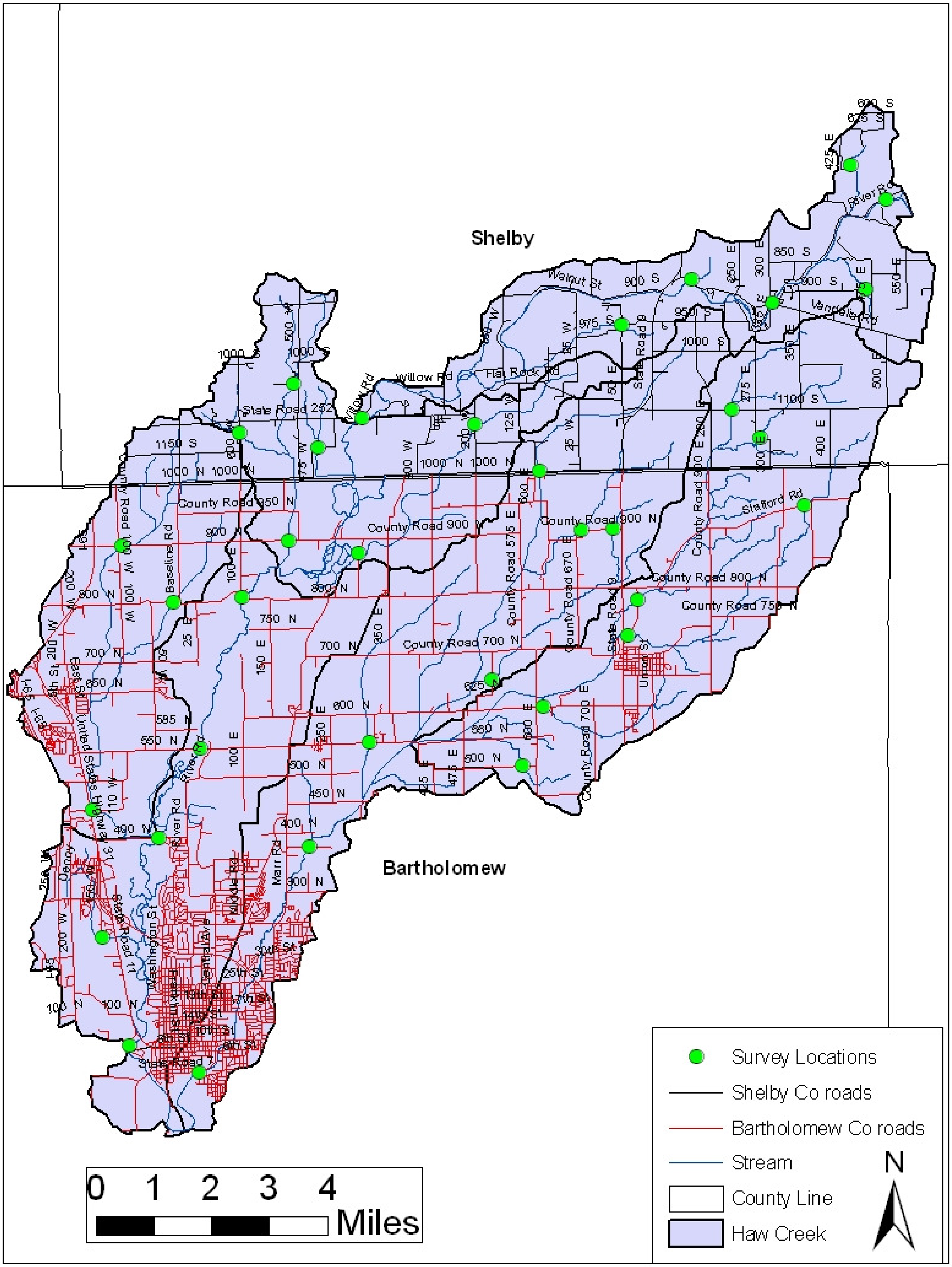
Concerns	Average Rank* (all people at public meeting)
Lack of education pertaining to water quality issues	3.57
Trash & Debris along stream banks	2.89
Erosion (sedimentation)	2.45
Chemical contamination (nitrates, phosphates)	2.41
Biological contamination (E. coli)	2.32
Other (biological contaminants other than E.coli)	1.5 (only 2 people checked other)
Rate of water leaving Flatrock-Haw Creek Watershed	Added by committee
Lack of pervious surfaces in urban areas	Added by committee
Maintain/Improve Recreation (fishing, swimming)	Added by committee

**Ranked on a scale of 1 to 5, with 1 as the highest priority and 5 as the lowest priority*

5.2 Windshield Survey Data

To help collect additional information a windshield survey of the watershed was completed. Thirty-four (34) sites throughout the watershed were analyzed for factors such as erosion, trash along the stream, land use, existence and width of buffers, algae presence and stream shading. Refer to Figure 5.2 for windshield survey locations. Erosion was observed during the surveys though it was occasional at worst; no sites were severely eroded. Minimal trash along the stream was observed though two sites were noted as dump sites (in the Sidney Branch-Flatrock River and the Little Haw Creek-Haw Creek sub watersheds). The land use at the survey sites was majorly agriculture, which corresponds with the overall land use in the watershed. Almost all of the sites had existing buffers of grass, shrubs, and/or trees though the buffers varied in widths of five to three hundred feet. There was algae present at approximately half of the survey sites most of which was attached to the substrate. Finally, most of the stream was either partly or mostly shaded. Only five sites had no shading, mostly because the buffer was grass directly along the stream (Big Slough, Little Haw Creek-Haw Creek and Town of Northcliff-Flatrock River sub watersheds).

Figure 5.2 Windshield survey locations



5.3 Pollutant runoff estimates and specific sources

Pollutant runoff estimates were calculated on a sub watershed basis for nitrogen, phosphorus, and suspended sediment. Urban land use is divided into high and low density while agricultural includes just row crops. Purdue University's Long-Term Hydrologic Impact Assessment (L-THIA) tool was used for the calculation. L-THIA is designed to help planners and local citizens determine the impact that land use has on water quantity and quality. The tool uses local rainfall data, land use and soil characteristics to determine runoff volume and pollutant loading. For all of the sub watersheds, the rainfall and soil characteristics were the same while land use varied slightly. This influenced all six sub watersheds having similar pollutant loads by land use type although runoff volumes are different. L-THIA outputs loads in pounds of nitrogen, phosphorus, and suspended sediment as well as annual runoff volumes. From this data concentrations were calculated. Concentration times the runoff volume equals the load value, though units were converted to get to the below data. In the following sections the annual average concentration, annual runoff volume and annual load estimates are listed for each of the six sub watersheds based on land use.

5.3.1 Town of Geneva-Flatrock River

Figure 4.3.1 shows the outline of the sub watershed as well as the current and past water quality data and the confined feeding operation locations. There were seven sites where data was recorded using the windshield survey in this sub watershed. At all of the sites the water color was noted as green but there was only limited algal growth. At all of the sites there were buffers present along the stream that ranged from twenty to three hundred feet in width and minor erosion was noted at all sites, except one which had an artificial bank. Of the historic data that was taken in this sub watershed there were 2 samples slightly above the nitrate-N standard, four samples above the target for total phosphorus and seventeen samples above the target for total suspended solids. In addition, there were seven samples between 2000 through 2004 that were above the E.coli standard. The TMDL site 11 also showed two values above the standard in 2002 with one of the sample above 2400 cfu/100 mL. In addition, the historic data at the project water monitoring site in this sub watershed has shown E.coli exceeding the standard three of seven months of data and total phosphorus exceeding the target level twice. Table 5.3.1 shows the L-THIA estimates for the sub watershed based on land use. The pollutant concentrations that are above target limits are suspended sediment and phosphorus with both urban and the agricultural land uses. Biological, nutrient and sediment pollutant sources that have been noted during public and technical meetings include a small dairy farm that is directly adjacent to the stream, a few small horse farms with stream access, a large geese population that overwinters, conventional tillage, runoff from yards and septic systems around Geneva. These septic systems are on-site systems with barriers that include small lots, poor soils for septic systems and the depth to bedrock is only thirty-six inches. Additionally, many of the residents receive their water from individual wells, which have a potential to become contaminated by septic systems that do not function properly. Identified potential point sources include confined feeding operations.

Table 5.3.1 L-THIA for Town of Geneva-Flatrock River

Land use	**Acres**	**N (lbs)**	**P (lbs)**	**TSS (lbs)**	**Runoff Volume (L)**
High Density Urban	34.20	120.58	37.76	2,716.47	30,053,591
Low Density Urban	669.26	667.03	208.90	15,026.19	166,233,219
Forest	1,574.01	158.93	2.30	227.00	102,967,414
Grass/ Pasture	103.73	18.13	0.26	25.89	11,745,016
Agricultural	8,112.05	25,282.74	7,469.85	614,838.42	2,606,390,952
Water	213.75	0	0	0	0
Total	**10,707**	**26,247.41**	**7,719.07**	**632,833.97**	**2,917,390,192**

Total Concentration in watershed (mg/L)	**4.08**	**1.20**	**98.39**

5.3.2 Sidney Branch-Flatrock River

Figure 4.3.2 shows the outline of the sub watershed as well as the current and past water quality data sites. There were five sites where data was recorded using the windshield survey in this sub watershed. At all of the sites there were buffers present along the stream that ranged from ten to one hundred feet in width and minor erosion was noted at all sites. One site was noted as a dump site since cars, appliances and tires were found adjacent to and within the stream. Of the historic data that was taken in this sub watershed in 1997 the E.coli standard was exceeded twice. In addition, the historic data at the project water monitoring site in this sub watershed has shown E.coli exceeding the standard four of seven months of data. Table 5.3.2 shows the L-THIA estimates for the sub watershed based on land use. The pollutant concentrations that are above target limits are suspended sediment and phosphorus with both urban and the agricultural land uses. Sediment, nutrient and biological pollutant sources that have been noted during public and technical meetings include stream bank erosion in the southern portion of the sub watershed, conventional tillage in river bottoms, and runoff from yards and septic systems around Flatrock. The septic systems in this area are on-site systems with similar barriers as the Geneva area; which include small lots and poor soils for septic systems. Residents also rely on individual wells for their drinking water.

Table 5.3.2 L-THIA for Sidney Branch-Flatrock River

Land use	Acres	N (lbs)	P (lbs)	TSS (lbs)	Runoff Volume (L)
High Density Urban	81.07	217.67	68.17	4,903.58	54,250,015
Low Density Urban	479.11	388.36	121.63	8,748.64	96,784,728
Commercial	4.00	15.34	3.66	635.38	5,192,910
Forest	864.60	69.75	1.01	99.62	45,189,817
Grass/ Pasture	859.88	95.98	1.34	137.11	62,195,073
Agricultural	8,377.56	22,383.77	6,613.41	544,340.94	2,307,532,243
Water	45.54	0	0	0	0
Total	**10,711.76**	**23,170.87**	**6,809.22**	**558,865.27**	**2,571,144,786**

Total Concentration in watershed (mg/L)	**4.09**	**1.20**	**98.59**

5.3.3 Big Slough

Figure 4.3.3 shows the outline of the sub watershed as well as the current water quality data site and the confined feeding operation locations. There were three sites where data was recorded using the windshield survey in this sub watershed. At all of the sites the water color was noted as brown or green. At all of the sites buffers were present along the stream but only one site had a 50-60 foot buffer while the other two were less than 10 feet wide. Because of the lack of flow in Big Slough most of the year no historic data exists for the sub watershed. The project water monitoring site in this sub watershed has not shown any data above standards but only two samples have been collected since only storm flow samples are collected after an inch or more of rain. Table 5.3.3 shows the L-THIA estimates for the sub watershed based on land use. The pollutant concentrations that are above target limits are suspended sediment and phosphorus with both urban and the agricultural land uses. Biological and sediment pollutant sources that have been noted during public and technical meetings include runoff from yards, new construction along Interstate 65 and bare soil exposure where a group of trees is being removed. Identified potential point sources include confined feeding operations.

Table 5.3.3 L-THIA for Big Slough

Land use	Acres	N (lbs)	P (lbs)	TSS (lbs)	Runoff Volume (L)
High Density Urban	408.37	1,833.67	574.28	41,307.90	457,008,361
Low Density Urban	1,017.48	1,279.00	400.57	28,812.30	318,753,450
Industrial	19.00	61.33	13.63	2,945.05	22,080,434
Commercial	139.39	682.65	163.02	28,273.72	231,081,611
Forest	376.69	32.44	0.47	46.34	21,018,404
Grass/ Pasture	354.25	56.41	0.80	80.58	36,551,479
Agricultural	8,241.46	20,395.47	6,025.99	495,988.94	2,102,556,934
Water	16.31	0	0	0	0
Total	**10,572.95**	**24,340.97**	**7,178.76**	**597,454.83**	**3,189,050,673**

Total Concentration in watershed (mg/L)	**3.46**	**1.02**	**84.98**

5.3.4 Haw Creek

Figure 4.3.4 shows the outline of the sub watershed as well as the current water quality data site and the confined feeding operation locations. There were seven sites where data was recorded using the windshield survey in this sub watershed. At all of the sites there were buffers present along the stream that ranged from 40 to 500 feet in width. There has been no historic data collected within the sub watershed. The project has shown E.coli values above the standard three of seven months and total phosphorus has been above the target level once since beginning collection. Also, the Town of Hope ground water is unable to be used due to high nitrate levels. Table 5.3.4 shows the L-THIA estimates for the sub watershed based on land use. The pollutant concentrations that are above target limits are suspended sediment and phosphorus with both urban and the agricultural land uses. Biological, nutrient and sediment pollutant sources that have been noted during public and technical meetings include conventional tillage operations, stream bank erosion upstream of the Hope lift station, a large dump site on County Road 550N, runoff from yards and the geese that overwinter at the Hope Waste Water Treatment Plant. Identified potential point sources include confined feeding operations and a wastewater treatment plant.

Table 5.3.4 L-THIA for Haw Creek

Land use	**Acres**	**N (lbs)**	**P (lbs)**	**TSS (lbs)**	**Runoff Volume (L)**
High Density Urban	347.92	1,621.97	507.97	36,538.79	404,246,676
Low Density Urban	751.67	872.84	273.36	19,662.45	217,524,641
Industrial	19.47	72.99	16.22	3,504.97	26,278,586
Commercial	65.56	347.46	82.97	14,390.89	117,617,059
Forest	1,244.67	128.31	1.86	183.28	83,137,854
Grass/ Pasture	341.38	60.18	0.85	85.96	38,993,456
Agricultural	13,536.14	46,074.80	13,612.85	1,120,469.00	4,749,843,325
Water	32.25	0	0	0	0
Total	**16,339.06**	**49,178.55**	**14,496.08**	**1,194,835.34**	**5,637,641,597**

Total Concentration in watershed (mg/L)	**3.96**	**1.17**	**96.14**

5.3.5 Little Haw Creek-Haw Creek

Figure 4.3.5 shows the outline of the sub watershed as well as the past and current water quality data sites and the confined feeding operation locations. There were seven sites where data was recorded using the windshield survey in this sub watershed. At all of the sites the water color was noted as murky and it was noted that the data was collected the day after a heavy rain. There was also one dump site with a mattress and tires. Historic data in the sub watershed is at TMDL site 16 which showed two samples above the E.coli standard in 1997. The project water monitoring sites in this sub watershed has also shown an exceedance of E.coli and total phosphorus. At the north site six of the seven months that data has been collected has exceeded the E.coli standard and one month the total phosphorus target was also exceeded. At the south site five of seven months of data has been above the E.coli standard. Table 5.3.5 shows the L-THIA estimates for the sub watershed based on land use. The pollutant concentrations that are above target limits are suspended sediment and phosphorus with both urban and the agricultural land uses. Biological and sediment pollutant sources that have been noted during public and technical meetings include horses with stream access during the winter, construction along US31 and County Road 600N, conventional tillage in river bottoms, runoff from yards and septic systems around Clifford and St. Louis Crossing. The sewage disposal in these areas includes on-site systems as well as individual drains. Barriers to septic systems include small lots and poor soils. Residents also rely on individual wells for drinking water. Identified potential point sources include confined feeding operations.

Table 5.3.5 L-THIA for Little Haw Creek-Haw Creek

Land use	**Acres**	**N (lbs)**	**P (lbs)**	**TSS (lbs)**	**Runoff Volume (L)**
High Density Urban	1,014.64	4,971.27	1,556.91	111,989.60	1,238,994,166
Low Density Urban	1,632.03	2,217.01	694.34	49,943.06	552,524,474
Industrial	273.32	963.12	214.02	46,244.72	346,719,511
Commercial	496.09	2,648.38	632.44	109,689.95	896,497,371
Forest	1,154.72	132.96	1.92	189.91	86,144,123
Grass/ Pasture	404.36	94.25	1.34	134.63	61,068,015
Agricultural	14,905.94	47,520.03	14,039.92	1,155,615.42	4,898,827,197
Water	13.17	0	0	0	0
Total	**19,894.27**	**58,547.02**	**17,140.89**	**1,473,807.29**	**8,080,774,857**

Total Concentration in watershed (mg/L)	**3.29**	**0.96**	**82.73**

5.3.6 Town of Northcliff-Flatrock River

Figure 4.3.6 shows the outline of the sub watershed as well as the past water quality data sites. There were five sites where data was recorded using the windshield survey in this sub watershed. At all of the sites the water color was noted as brown and murky, also noted was that the data was collected the day after a heavy rain. At all of the sites there were buffers present along the stream that ranged from as little as five to two hundred feet wide. There are multiple sites where historic data has been collected in this sub watershed. In 1997, the SR11 site had one sample was above total phosphorus and E.coli targets/standards. Also, two samples were above the target levels for total suspended sediment. All three TMDL sites within the sub watershed showed at least two exceedances above the standard, and site 15 had five samples above with one exceeding 2400 cfu/100 mL. The project has no water monitoring sites in the watershed due to the width of Flatrock River, though there is an existing fixed site at the bottom of the sub watershed which the project plans to use for reference. Table 5.3.6 shows the L-THIA estimates for the sub watershed based on land use. The pollutant concentrations that are above target limits are suspended sediment and phosphorus with both urban and the agricultural land uses. Biological, sediment and nutrient pollutant sources that have been noted during public and technical meetings include new construction sites, conventional tillage in river bottoms, runoff from yards and septic systems around Barnaby Acres. This area has on-site systems, typically on smaller lots with poor soils for septic systems. Residents mostly rely on individual wells for their drinking water. Other potential sediment and nutrient sources include the airport, public access sites, an old landfill and an old creosote plant. Identified potential point sources include combined sewer systems.

Table 5.3.6 L-THIA for Town of Northcliff-Flatrock River

Land use	**Acres**	**N (lbs)**	**P (lbs)**	**TSS (lbs)**	**Runoff Volume (L)**
High Density Urban	1,335.85	6,351.90	1,989.30	143,091.66	1,583,090,245
Low Density Urban	1,771.55	2,570.20	804.97	57,899.51	640,551,479
Industrial	321.66	1,107.66	246.14	53,184.93	398,753,354
Commercial	558.33	2,921.21	697.59	120,990.04	988,853,106
Forest	1,584.86	189.89	2.74	271.22	123,026,002
Grass/ Pasture	483.56	104.65	1.49	149.49	67,811,308
Agricultural	9,065.21	20,355.94	6,014.37	495,028.46	2,098,478,710
Water	500.24	0	0	0	0
Total	**15,621.26**	**33,601.45**	**9,756.60**	**870,615.31**	**5,900,564,204**

Total Concentration in watershed (mg/L)	**2.58**	**0.75**	**66.93**

5.4 Problem Statements and Goals

In order to address the local concerns raised by the stakeholders at the public meetings the steering committee created several problem statements. Additional information came from a technical meeting and windshield surveys throughout the watershed. The statements help to give a condensed version of the concerns along with what can action can be taken to address them. The problems described below in Table 5.4 indicate sources that are both point and nonpoint in nature, though the scope of the project will focus on the nonpoint sources as the point sources are better regulated. This table highlights the problem statements and associated sources; more detail about each individual problem statement follows the table. Although trash and other biological contaminant concerns were noted during the first public meeting later data from the windshield surveys and technical meeting determined that these issues were minimal throughout the watershed and no problem statements were created for these contaminants. Additionally, building in floodplains was identified as a concern. Currently no building is being allowed in floodplains but this concern may be brought back if regulations change.

Table 5.4 Pollutants, potential sources, the impacts on use and associated problem statements.

Concern	Pollutant/Stressor	Potential Sources		Impacts on Water body Uses	Problem Statement
		Nonpoint Sources	Point Sources		
Lack of Education	A lack of education will create additional problems if landowners aren't aware of how their actions affect water quality	N/A	N/A	Indirect impacts to water quality from pollution Lack of water quality improvement due to lack of awareness changes	A lack of knowledge in the community about water quality issues and potential sources may have led to increased stream degradation
Erosion (sedimentation)	Sediment	Agricultural Operations Stream Banks In-stream erosion Gully Erosion Construction areas	N/A	Indirect impacts to recreation fishing Impairs swimming/boating due to channel alteration Total Suspended Solids interrupts fish feeding and alters stream temperature	Sedimentation is a significant problem in Flatrock-Haw Creek Watershed. This may result from overland runoff from agricultural and construction areas. This may also result from in-stream and stream bank erosion potentially caused by the high rate of water leaving the stream, a lack of vegetation along the banks, and unrestricted livestock access.

Concern	Pollutant/Stressor	Potential Sources		Impacts on Water body Uses	Problem Statement
		Nonpoint Sources	Point Sources		
Nutrient contamination	Non-point source chemical runoff	Agricultural Fields Septic Systems Yards Livestock Wildlife and pets	Waste Water Treatment Plants Combined Sewer Overflows CAFOs	Excess algae growth in stream systems can cause problems with recreation Excess algae die off causes low dissolved oxygen in water Indirect impacts to recreation fishing High levels have the potential to cause fish toxicity	Overland and subsurface runoff from agricultural operations, private homeowners' yards, and wildlife can cause chemical contaminations of nutrients. Nutrient contamination can also occur with failing septic systems, combined sewer overflows, and from waste water treatment plants.
Biological contamination (E. coli)	E. coli	Livestock Manure application on agricultural fields Wildlife and pets Septic Systems	Waste Water Treatment Plants Combined Sewer Overflows CAFOs	Human health risks, particularly with secondary contact Risk of illness to livestock that may use stream as primary drinking source	Biological contamination occurs in the Flatrock-Haw Creek Watershed potentially due to overland runoff from feedlots, unrestricted livestock access to streams, wildlife, and failing septic systems. During high rain events a combined sewer overflow system can also cause contamination of biological pathogens.

Concern	Pollutant/Stressor	Potential Sources		Impacts on Water body Uses	Problem Statement
		Nonpoint Sources	Point Sources		
Maintain/Improve Recreation (fishing, swimming)	Lack of recreation due to poor water quality	Agricultural operations Bank erosion In-stream erosion Septic systems Yards	Waste Water Treatment Plants Combined Sewer Overflows CAFOs	Indirect impacts from sediment and biological contamination can lead to reduced fish habitat and poor water quality for swimming.	There may be a lack of recreation, particularly recreational fishing and swimming, due to degraded water quality or a lack of water during summer months. Increased sedimentation and chemical contaminants may have led to decreased fish habitat while biological pathogens have created hazards for swimming. The decreased fish habitat is also tied to decreased biological community in FR-HC.
Rate of water leaving Flatrock-Haw Creek Watershed Lack of pervious surfaces in urban areas	Lack of pervious surfaces	Parking lots Roads Driveways	Combined Sewer Overflows	If water moves too quickly over the ground it doesn't have time to settle out sediment and nutrients that it has picked up. Additionally, increased speed of water can lead to increase of in-stream and stream bank erosion.	A lack of pervious surfaces and an increased infrastructure in major urban areas such as Columbus may have created more flash events in the Flatrock-Haw Creek Watershed; which can add to in-stream erosion. Runoff from parking lots can lead to other chemical contamination including oils and salt.

5.4.1 Lack of education

Problem: *A lack of knowledge in the community about water quality issues and potential sources has led to increased stream degradation.*

A survey was distributed at the public meeting to help assess the knowledge of attending stakeholders (Appendix B). Some of the questions asked included define a watershed and identifying nonpoint source pollution. 67% of the survey respondents correctly identified a watershed while the rest of the respondents had a general idea of the definition. Although many of those surveyed accurately defined a watershed there were few that correctly identified nonpoint source pollution. Increasing awareness about water quality issues is important but if the stakeholders do not see how the issues affect their lives they may show less interest. To help determine interest levels survey respondents were also asked how water quality influenced their decisions, both on a personal and community level.

Table 5.4.1-1 Watershed results from the public meeting

Knowledge questions	Number Correct	Incorrect
Define a watershed	16	8
Identify nonpoint sources	5	20

Table 5.4.1-2 Additional watershed results from the public meeting

Opinion Questions	High	Medium	Low
Influence of water quality on personal decisions	15	9	0
Influence of water quality on community decisions	22	2	1

Table 5.4.1-3 Problem 1, Goal 1

Goal 1: Work to increase non-point source pollution awareness within local community groups.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding /Match Sources**
Promote urban/suburban BMP's	Host urban practice field day/workshop	Homeowner's Association, Urban Landowners	Watershed Project staff and steering committee, SWCD staff, other partners	Phase I: 2011-2014	Number of attendees at field days, surveys after field days/workshops, number of media releases focused on urban BMPs	100 dollars 150 dollars match	319 grant, SWCD Match from private sponsors and speakers time
	Promote urban soil testing	Homeowner's Association, Urban Landowners	Watershed Project staff and steering committee, SWCD staff and Board, Purdue Extension	Phase I: 2011-2020		200 dollars 100 dollars match	319 grant and SWCD printing and staff time Match from Purdue Extension for staff time
	Highlight innovative urban BMP practices	Homeowner's Association, Urban Landowners, Commercial Businesses	Watershed Project staff, SWCD staff, local landowners	Phase I: 2011-2014		500 dollars for staff time for creation and submission of media releases	319 grant and SWCD

Goal 1: Work to increase non-point source pollution awareness within local community groups.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding /Match Sources**
	Host field day/workshop featuring field management techniques	Agriculture owners/operators, Contractors, and Local Co-ops	Watershed Project staff and steering committee, SWCD staff and Board members, local landowners	Phase I: 2011-2014		100 dollars 150 dollars match	319 grant and SWCD Match from private sponsors and speakers time
	Develop and update website page		Watershed Project staff	Quarterly, Phase I: 2011-2014		1,500 dollars for web host cost and staff time for updating	319 grant and SWCD
	Host field day/workshop on non point source pollution issues	Urban/Suburban residents, agricultural owners/operators, educators, businesses, and public officials	Watershed Project staff and steering committee, SWCD staff, other partners	Phase I: 2011-2014		100 dollars from 319 grant and SWCD. 150 dollars match	319 grant and SWCD Match from private sponsors and speakers time
	Create and distribute project newsletter	Urban/Suburban residents, agricultural owners/operators, educators, businesses, and public officials	Watershed Project staff	Quarterly, Phase I: 2011-2014		1000 dollars for 319 grant staff time for creation and distribution.	319 grant
	Submit articles to partner newsletters		Watershed Project staff	Quarterly, Phase I: 2011-2014		250 dollars for 319 grant staff time for creation	319 grant

Goal 1: Work to increase non-point source pollution awareness within local community groups.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding /Match Sources**
	Host displays at local events	Urban/Suburban residents, agricultural owners/operators, Businesses, and public officials	Watershed Project staff and steering committee and SWCD staff and Board	Phase I: 2011-2014 Phase II: 2015-2020	number of events participated in	1000 dollars for 319 and SWCD staff time, materials and booth space rental. 3000 dollars match	319 grant and SWCD Match from volunteer time
	Build contact list of over 100 individuals	Urban/Suburban residents, agricultural owners/operators, Businesses, and public officials	Watershed Project staff and steering committee and SWCD staff	Phase I: 2011-2014	Number of individuals on newsletter distribution list	200 dollars for 319 staff time for contact with individuals. 100 dollars match	319 grant Match from SWCD staff and steering committee time

Table 5.4.1-4 Problem 1, Goal 2

Goal 2: Increase community involvement and education by hosting/participating in local events. Project will offer 500 hours of water quality education to students and adults by 2015							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/Match Sources**
Offer development opportunities in conservation and natural resource fields	Mentor local youth students/groups	Boy Scouts, Girl Scouts, Student led clubs, Senior project students participants	Watershed Project staff and SWCD staff	Phase I: 2011-2014	Number of education events with targeted groups, participant evaluations, number of projects	2500 for staff 2500 match	319 grant Match from SWCD
	Become involved with local conservation oriented groups	Energy Matters Community Coalition (EMCC), Sierra Club, Drainage Boards, Cummins Environmental Group	Watershed Project staff and steering committee and SWCD staff	Phase I: 2011-2014		1500 dollars for staff time. 1500 dollars match	319 grant Match from SWCD and steering committee time
Provide public education at local events	Host displays at local events	General public, all ages	Watershed Project staff and steering committee and SWCD staff and Board	Phase I: 2011-2014	Number of events, number of participants at events	1000 dollars 3000 dollars match	319 and SWCD Match from volunteer time
	Hold stream cleanup events	General public	Watershed Project staff and steering committee and SWCD staff	Bi-annual, Phase I: 2011-2014		300 dollars 9500 dollars match	319 grant and SWCD Match from volunteer time

Goal 2: Increase community involvement and education by hosting/participating in local events. Project will offer 500 hours of water quality education to students and adults by 2015							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding /Match Sources**
	Develop and host youth education programs	Educators, students, student led groups	Watershed Project staff and steering committee and SWCD staff	Phase I: 2011-2014		2500 dollars 2500 match	319 grant Match from SWCD

5.4.2 Increased sedimentation

Problem: *Sedimentation is a significant problem in Flatrock-Haw Creek Watershed. This may result from overland runoff from agricultural and construction areas. This may also result from in-stream and stream bank erosion potentially caused by the high rate of water leaving the stream, a lack of vegetation along the banks, and unrestricted livestock access.*

The technical and public meetings provided the majority of the information on where problems with sedimentation exist. There are areas in bottomlands that are still conventionally tilled, areas where livestock have in-stream access, and areas where gully erosion exist. In addition, there are several new construction areas within the watershed. Also, there is one site in the watershed a group of trees will be removed near the stream. The windshield surveys showed that stream bank erosion, while minimal, is occurring throughout the watershed. Gully erosion was identified as a resource concern at the local working group for the Environmental Quality Incentive Program (EQIP). Finally, past water quality data collected by IDEM shows multiple samples above the target limit at both of their fixed station sites.

Load reduction goals were determined based on the L-THIA tool and Watershed Project data as well as other inputs. L-THIA estimate tables provided us with the annual pollutant load estimates, while the percentage reduction goals were provided from the Watershed Project data as well as other inputs. Based on L-THIA estimates a reduction of 65% is needed to reduce total suspended solids to the target level. The current load of TSS based on L-THIA estimates is 2,664 tons/year. As sediment contamination also occurs naturally in the form of stream bank erosion the steering committee decided to set a longer term goal for this contaminant than the others. Additionally, based on the past project data there are some indications of potentially higher loads so an overall goal of 75% reduction was set between now and 2036.

Table 5.4.2-1 Problem 2, Goal 1

Goal 1: Reduce sediment loading into streams by twenty-five percent (25%) (666 tons/year) by 2016, by fifty percent (50%) (1,332 tons/year) by 2026 and by seventy-five percent (75%) (1,998 tons/year) by 2036 through increased awareness and implementation of best management practices.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/Match Sources**
Reduce speed and quantity of water runoff	Install urban/suburban BMP's that reduce storm flow	Urban/suburban residents, homeowners associations, Businesses	Watershed Project staff, SWCD staff, Contractors	Phase I: 2011-2014 Phase II: 2015-2020 Phase III: 2021-2036	Number of BMPs installed, sediment loading numbers.	15,000 dollars funding for rain barrels, rain garden/bioswale, porous pavement 5,000 dollars match for rain barrels, rain garden/bioswale, porous pavement	319 grant and SWCD Match from landowner portion of cost share
	Install agricultural practices that promote infiltration	Agriculture owners/operators, contractors, co-ops	Watershed Project staff, SWCD staff, NRCS	Phase I: 2011-2014 Phase II: 2015-2020 Phase III: 2021-2036		68,500 dollars funding for agricultural practices that promote infiltration. 23,000 dollars match for agricultural practices that promote infiltration	319 grant and SWCD Match from landowner portion of cost share

Goal 1: Reduce sediment loading into streams by twenty-five percent (25%) (666 tons/year) by 2016, by fifty percent (50%) (1,332 tons/year) by 2026 and by seventy-five percent (75%) (1,998 tons/year) by 2036 through increased awareness and implementation of best management practices.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/Match Sources**
Increase awareness of sediment loading issues	Host field days/workshops focused on BMP's that reduce sediment loading	Urban/suburban residents, agricultural owners/operators, contractors	Watershed Project staff and steering committee and SWCD staff	Phase I: 2011-2014	Number of field days, sediment loading values, post surveys.	100 dollars 150 dollars match	319 grant and SWCD Match from private sponsors and speakers time
Increase acreage of cover crops	Create and distribute fact sheet of cover crop options and benefits	Agriculture owners/operators, contractors, co-ops	Watershed Project staff	Current, to be completed by 2012	Number of acres in cover crops, awareness of cover crops, number of field days.	200 dollars	319 grant
	Promote use of cover crops in conventional systems		Watershed Project staff and steering committee and NRCS	Phase I: 2011-2014 Phase II: 2015-2020 Phase III: 2021-2036		200 dollars 2000 dollars match	319 grant and SWCD Match from EQIP projects in watershed and steering committee time
	Host field day/workshop on cover crops		Watershed Project staff and SWCD staff	Phase I: 2011-2014		100 dollars 150 dollars match	319 grant and SWCD Match from private sponsors and speakers time

Goal 1: Reduce sediment loading into streams by twenty-five percent (25%) (666 tons/year) by 2016, by fifty percent (50%) (1,332 tons/year) by 2026 and by seventy-five percent (75%) (1,998 tons/year) by 2036 through increased awareness and implementation of best management practices.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/Match Sources**
Promote use of riparian buffers along stream corridors	Promote NRCS programs that install grass/tree buffers along field edges	Agriculture owners/operators	Watershed Project staff and NRCS	Phase I: 2011-2014 Phase II: 2015-2020 Phase III: 2021-2036	Number of acres in buffers, cost share post survey results.	100 dollars	319 grant
	Promote tree/shrub planting along stream corridors	Urban/suburban residents	Watershed Project staff and SWCD staff	Phase I: 2011-2014		100 dollars	319 grant and SWCD
Encourage implementation of conservation tillage practices	Distribute fact sheet on advantages/disadvantages of no-till vs. conventional till	Agriculture owners/operators, contractors, co-ops	Watershed Project staff and steering committee	Current, to be completed by 2012	Number of equipment modifications, acres of conservation tillage, cost share post survey results, ISDA survey	200 dollars 100 dollars match	319 grant Match from steering committee time
	Offer modifications so equipment can be used for conservation tillage		Watershed Project staff	Phase I: 2011-2014		50,000 dollars funding for project implementation 75,000 dollars match for project implementation	319 grant Match from landowner cost share portion

Goal 1: Reduce sediment loading into streams by twenty-five percent (25%) (666 tons/year) by 2016, by fifty percent (50%) (1,332 tons/year) by 2026 and by seventy-five percent (75%) (1,998 tons/year) by 2036 through increased awareness and implementation of best management practices.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/Match Sources**
Reduce gully and stream bank erosion	Promote existing conservation programs that address erosion issues	Agriculture owners/operators, contractors, forest owners/managers	Watershed Project staff and steering committee, NRCS, SWCD staff and Board	Phase I: 2011-2014 Phase II: 2015-2020 Phase III: 2021-2036	Sediment load reductions	150 dollars 100 dollars match	319 grant and SWCD Match from steering committee and SWCD time
Encourage implementation of livestock practices	Reduce livestock access to streams	Livestock producers	Watershed Project staff, NRCS, SWCD staff	Phase I: 2011-2014 Phase II: 2015-2020 Phase III: 2021-2036	Number of livestock excluded from stream, number of grazing plans, sediment load reductions	5,000 dollars for funding for practices such as fencing, pipeline, heavy use area protection, water well development, and water tanks 1,700 dollars match for practices to reduce access	319 grant Match from landowner cost share portion
	Increase pasture cover by promoting grazing plans and pasture/hay seeding	Livestock producers	Watershed Project staff, NRCS, SWCD staff	Phase I: 2011-2014 Phase II: 2015-2020 Phase III: 2021-2036	Number of livestock excluded from stream, number of grazing plans, sediment loads	6,000 dollars for funding for pasture/hay seeding and prescribed grazing plan practices 2,000 dollars match for pasture practices	319 grant and SWCD Match from landowner cost share portion

5.4.3 Biological Contamination

Problem: *Biological contamination occurs in the Flatrock-Haw Creek Watershed due to overland runoff from feedlots, unrestricted livestock access to streams, wildlife, and failing septic systems. During high rain events the combined sewer overflow system also causes contamination of biological pathogens.*

The concern for biological contamination, namely E. coli, comes mostly from past and current water quality data. IDEM currently has a TMDL for the larger Flatrock-Haw Creek Watershed. The TMDL for E. coli estimated load reductions is required to meet Indiana Water Quality Standards at the six sites in the watershed. The WMP E. coli goals are designed to meet Indiana Water Quality Standards at the project sites. Data collected at multiple sites has shown values well above the standard limit. Additionally, current data collected by the project has shown multiple samples that have exceeded the standard since May 2009. During the public and technical meetings general sources noted include livestock with creek access, geese that overwinter, and several small communities that rely on septic systems.

The City of Columbus is currently in the process of correcting the long-standing Combined Sewer Overflow (CSO) as required by State's long term control plan. The CSO's are direct discharges of untreated waste into local waters during high storm-flow events due to the system not being able to handle the combination of sewer and rainfall amounts. The completion of this project is expected in 2011.

Load reduction goals were determined based on current water quality data and requirements by IDEM. The minimum goal for E.coli is to reduce the contamination to below the standard level of 235 cfu/100 mL. The steering committee believes this is a good target to achieve, as this will also help to improve water quality which affects recreation. Current E.coli levels from IDEM shows spikes over 2400 cfu/100 mL and geometric means above the state standard for primary contact. Also, Flatrock-Haw Creek Water Monitoring data has shown E.coli levels exceeding the 235 cfu/100 mL levels, with one sampl spiking at 13,333 cfu/100 mL. The TMDL requires a reduction of 70-80% in the Flatrock River and approximately 50% reduction in Haw Creek.

Table 5.4.3-1 Problem 3, Goal 1

Goal 1: Reduce E.coli average values at watershed project monitoring sites to at least the water quality standard of 235 cfu/100 mL by 2026. This will be achieved by increasing awareness of biological contamination source issues and the implementation of conservation practices.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/ Match Sources**
Promote proper use and maintenance of septic systems	Host field day/workshop on septic system education	Landowners with septic systems	Watershed Project staff and steering committees and SWCD staff, SWMD	Phase I: 2011-2014	Water quality data number of field days, post-survey results.	100 dollars 150 dollars match	319 grant and SWCD Match from private sponsors and speakers time
Promote appropriate design and maintenance of septic systems	Host field day/workshop on septic installation and design	Contractors who install septic systems	Watershed Project staff, SWCD staff and contractors	Phase I: 2011-2014	Number of septic systems influenced, water data data	100 dollars 150 dollars match	319 grant and SWCD Match from private sponsors and speakers time
Encourage implementati on of livestock practices	Reduce livestock access to streams	Livestock producers	Watershed Project staff, NRCS, SWCD staff	Phase I: 2011-2014 Phase II: 2015-2020	Number of livestock excluded from stream, number of grazing plans, sediment load reductions	5,000 dollars for funding for practices such as fencing, pipeline and water tanks 1,700 dollars match for practices to reduce access	319 grant and SWCD Match from landowner cost share portion

Goal 1: Reduce E.coli average values at watershed project monitoring sites to at least the water quality standard of 235 cfu/100 mL by 2026. This will be achieved by increasing awareness of biological contamination source issues and the implementation of conservation practices.

Objective	Action Item	Target Audience	Responsible party	Schedule	Indicators	Funding/Match Estimates	Potential Funding/ Match Sources
Increase awareness of wildlife and pet impact on water quality	Submit media releases and newsletter articles on subject	Urban/Suburban, and Rural landowners	Watershed project staff, steering committee and SWCD staff, MS4 staff	Phase I: 2011-2014 Phase II: 2015-2020	Number of articles and media releases	250 dollars 250 dollars match	319 grant Match from steering committee, SWCD and MS4 time
Monitor progress on E.coli reductions	Continue water monitoring program	Urban/suburban, rural and agricultural landowners	Watershed staff, steering committee, water monitor volunteers	Phase I: 2011-2014	Number of volunteers, water quality data	15,000 dollars 15,500 dollars match	319 grant Match from volunteer time
Promote proper application of manure	Promote use of comprehensive nutrient management plans	Livestock producers	Watershed Project staff and NRCS	Phase I: 2011-2014 Phase II: 2015-2020	Number of CNMPs/waste utilization plans, water quality data	200 dollars	319 grant
	Promote use of waste management practices using NRCS standards	Livestock producers, agricultural operators who apply manure	Watershed Project staff and NRCS	Phase I: 2011-2014 Phase II: 2015-2020		10,000 for funding of practices and 319 staff time for promotion. 20,000 dollars match for funding of practices	319 grant Match from landowner cost share portion

5.4.4 Non-point source Nutrient Runoff

Problem: *Nutrient contamination occurs in the Flatrock-Haw Creek due to overland and subsurface runoff from agricultural operations, private homeowners' yards, and wildlife. Nutrient contamination also occurs from failing septic systems, combined sewer overflows and from waste water treatment plants.*

While both urban and agricultural landowners may not be applying large amounts of nitrates and phosphates they may be applying them improperly due to the lack of soil testing and/or use of nutrient management plans. Also, the agricultural fields areas are extensively tile drained and many legal drains exist which help nutrients reach streams. In addition there is an old landfill and an old creosote plant that exist in the watershed, though it is unknown if these areas are contributing pollutants. Additionally, there is approximately 6% of land use that is highly developed land which is correlated with impervious pavement, which increases contamination to the stream. IDEM's water quality data has shown a few samples that have exceeded the standard or target for nitrogen and phosphorus. Finally, current project data has shown a couple samples that have exceeded targets for phosphorus.

Load reduction goals were determined based on the L-THIA tool and Watershed Project data as well as other inputs. L-THIA estimate tables provided us with the annual pollutant load estimates, while the percentage reduction goals were provided from the Watershed Project data as well as other inputs. Based on L-THIA estimates a reduction of 90% is needed to reduce the phosphorus concentration to the target level. L-THIA estimates that the annual phosphorus load is 63,101 lbs. The steering committee has set the overall reduction for phosphorus to 75%. Based on L-THIA estimates nitrogen is already below the standard but water quality tests have shown values above the standard so the steering committee felt the need to set a goal to reduce both contaminants. L-THIA estimates that the annual nitrogen load is 215,086 lbs. While a 90% reduction is needed to achieve the target level based on L-THIA estimates; few samples from the project data have exceeded the target.

Table 5.4.4-1 Problem 3, Goal 1

Goal 1: Reduce nitrogen loads by twenty-five percent (25%) by 2016 (53,772 lbs/yr) and by fifty percent (50%) by 2026 (107,543 lbs/yr). Reduce phosphorus loads by twenty-five percent (25%) by 2016 (15,775 lbs/yr), by fifty percent (50%) by 2026 (31,550 lbs/yr) and by seventy-five percent (75%) in by 2031 (47,325 lbs/yr). This will be achieved by increasing awareness of nitrogen and phosphorus contamination source issues and the implementation of conservation practices.

Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/Match Sources**
Promote conservation practices that reduce nutrient runoff	Increase use of nutrient management plan	Agricultural owners/operators	Watershed Project staff and NRCS	Phase I: 2011-2014 Phase II: 2015-2020	Number of nutrient management plans, number of stream buffers, phosphorous/nitrogen loads.	15,000 dollars funding for nutrient management plans 5,000 dollars match for funding of plans	319 grant Match from landowner cost share portion
	Distribute information to Co-ops who apply nutrients/fertilizers	Commercial applicators, technical service providers	Watershed Project staff and steering committee	Initiated in first year, to be completed by 2013		300 dollars 100 dollars match	319 grant Match from steering committee time
	Increase use of stream buffers/field borders	Landowners along water bodies	Watershed Project staff and NRCS	Phase I: 2011-2014 Phase II: 2015-2020		100 dollars	319 grant

Goal 1: Reduce nitrogen loads by twenty-five percent (25%) by 2016 (53,772 lbs/yr) and by fifty percent (50%) by 2026 (107,543 lbs/yr). Reduce phosphorus loads by twenty-five percent (25%) by 2016 (15,775 lbs/yr), by fifty percent (50%) by 2026 (31,550 lbs/yr) and by seventy-five percent (75%) in by 2031 (47,325 lbs/yr). This will be achieved by increasing awareness of nitrogen and phosphorus contamination source issues and the implementation of conservation practices.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/Match Sources**
Increase homeowner awareness of lawn/soil requirements for nutrients	Support existing educational efforts by Cooperative Extension	Homeowners, master gardeners, and landscape professionals in the watershed and surrounding areas	Watershed Project staff, SWCD staff and Board and Cooperative Extension	Current, to be completed by 2014	Phosphorus/nitrogen loads, post-survey results.	100 dollars 200 dollars match	319 grant Match from SWCD
	Conduct field day/workshop for backyard conservation	Residents in the watershed	Watershed Project staff and steering committee and SWCD staff	Phase I: 2011-2014		100 dollars 150 dollars match	319 grant and SWCD Match from private sponsors and speakers time
Monitor progress on nutrient reductions	Continue water monitoring program	Urban/suburban, rural and agricultural landowners	Watershed staff, steering committee, water monitor volunteers	Phase I: 2011-2014	Number of volunteers, water quality data	15,000 dollars 15,500 dollars match	319 grant Match for volunteer time

Goal 1: Reduce nitrogen loads by twenty-five percent (25%) by 2016 (53,772 lbs/yr) and by fifty percent (50%) by 2026 (107,543 lbs/yr). Reduce phosphorus loads by twenty-five percent (25%) by 2016 (15,775 lbs/yr), by fifty percent (50%) by 2026 (31,550 lbs/yr) and by seventy-five percent (75%) in by 2031 (47,325 lbs/yr). This will be achieved by increasing awareness of nitrogen and phosphorus contamination source issues and the implementation of conservation practices.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding /Match Sources**
	Promote and install agricultural practices that reduce nitrogen and phosphorus runoff	Agricultural owners/operators, Co-ops, technical service providers	Watershed Project staff and NRCS	Phase I: 2011-2014 Phase II: 2015-2020		100,000 dollars funding for agricultural practices that reduce runoff such as conservation cover, control structures, and well as others. 40,000 dollars match for agricultural practices that reduce runoff conservation cover, control structures, and well as others.	319 grant Match from landowner cost share portion

5.4.5 Lack of recreation due to poor water quality

Problem: *There is a lack of recreation, particularly recreational fishing and swimming, due to degraded water quality or a lack of water during summer months. Increased sedimentation and chemical contaminants have led to decreased fish habitat while biological pathogens have created hazards for swimming. The decreased fish habitat is also tied to a decreased biological community in Flatrock-Haw Creek Watershed.*

This problem was noted during the public meetings and by the local steering committee. The current data has shown very few macroinvertebrates at all but one of the water monitoring sites. The average CQHEI value for the watershed is only 53. This is below the level noted to be conducive to warm water fauna. Many of the sites have sandy bottoms which is poor habitat for the macroinvertebrates. This is also tied to a lack of fish habitat since some fish species rely on these macroinvertebrates for food. The concerns with E.coli have reduced those that use the stream for swimming. The concerns regarding swimming are majorly an issue with the Flatrock River portion of the watershed while fishing occurs throughout the watershed.

Table 5.4.5-1 Problem 4, Goal 1

<table>
<tr><th colspan="8">Goal 1: Improve CQHEI values at all water quality sites to at least conducive to the existence of warm water fauna (>60) by 2020 through increased awareness and best management practice implementation.</th></tr>
<tr><th>Objective</th><th>Action Item</th><th>Target Audience</th><th>Responsible party</th><th>Schedule</th><th>Indicators</th><th>Funding/Match Estimates</th><th>Potential Funding/Match Sources</th></tr>
<tr><td rowspan="2">Promote practices that improve quality of riparian areas</td><td>Increase buffers along water bodies</td><td>Landowners adjacent to water bodies</td><td>Watershed Project staff and NRCS</td><td>Phase I: 2011-2014
Phase II: 2015-2020</td><td rowspan="2">Number of buffers installed, CQHEI values from water monitoring data.</td><td>100 dollars</td><td>319 grant</td></tr>
<tr><td>Promote natural streams</td><td>Landowners, public officials, contractors</td><td>Watershed Project staff</td><td>Phase I: 2011-2014
Phase II: 2015-2020</td><td>100 dollars</td><td>319 grant</td></tr>
</table>

Table 5.4.5-2 Problem 4, Goal 2

<table>
<tr><td colspan="8">Goal 2: Reduce contaminant loads to help improve water quality so that habitat for fish and macro-invertebrates are increased. A reduction in biological contaminant loads will also increase swimming use of Flatrock River. Reductions will be achieved through increased awareness and best management practice implementation.</td></tr>
<tr><th>Objective</th><th>Action Item</th><th>Target Audience</th><th>Responsible party</th><th>Schedule</th><th>Indicators</th><th>Funding/Match Estimates</th><th>Potential Funding/Match Sources</th></tr>
<tr><td rowspan="2">Promote practices that improve aquatic habitat</td><td>Increase buffers along water bodies</td><td>Landowners adjacent to water bodies</td><td>Watershed Project staff and NRCS</td><td>Phase I: 2011-2014
Phase II: 2015-2020</td><td rowspan="2">Contaminant loads, number of buffers installed, use of 2-stage ditches.</td><td>100 dollars</td><td>319 grant</td></tr>
<tr><td>Promote use of 2- stage ditches</td><td>Landowners, public officials, contractors</td><td>Watershed Project staff, NRCS, and The Nature Conservancy</td><td>Phase I: 2011-2014
Phase II: 2015-2020</td><td>200 dollars for 319 staff time

100 dollars match</td><td>319 grant

Match from Nature Conservancy</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Goal 2: Reduce contaminant loads to help improve water quality so that habitat for fish and macro-invertebrates are increased. A reduction in biological contaminant loads will also increase swimming use of Flatrock River. Reductions will be achieved through increased awareness and best management practice implementation.

Objective	Action Item	Target Audience	Responsible party	Schedule	Indicators	Funding/Match Estimates	Potential Funding /Match Sources
Reduce speed of water entering streams	Increase use of agricultural best management practices that promote water infiltration	Agricultural owners/operators	Watershed Project staff and NRCS	Phase I: 2011-2014 Phase II: 2015-2020	Contaminant loads, best management practices implementation, post-survey results of awareness.	68,500 dollars funding for agricultural practices that promote infiltration. 23,000 dollars match for agricultural practices that promote infiltration	319 grant Match from landowner cost share portion
Reduce contaminant loads to streams	Install best management practices that reduce contaminant loads	Urban/suburban landowners, agricultural owners/operators	Watershed Project staff, SWCD staff, and NRCS	Phase I: 2011-2014 Phase II: 2015-2020	Contaminant loads, BMPs installed. Number of press releases concerning aquatic habitat.	152,000 dollars 69,000 match	319 grant and SWCD Match from landowner cost share portion
	Distribute information about improving aquatic habitat	Residents in the watershed and surrounding areas	Watershed Project staff and SWCD staff	Phase I: 2011-2014		200 dollars	319 grant and SWCD

5.4.6 Rate of water leaving Flatrock-Haw Creek Watershed

Problem: *A lack of pervious surfaces and an increased infrastructure in major urban areas such as Columbus may have created more flash events in the Flatrock-Haw Creek Watershed; which adds to in-stream erosion. Runoff from parking lots contribute to other chemical contamination including oils and salt.*

This problem was noted by the local steering committee as urban development continues. Currently, 13.6% of the watershed is developed though only 6% of this is highly urbanized. The majority of this urban land use is in the city of Columbus. Education and awareness should be better utilized to address this problem.

Table 5.4.6-1 Problem 5, Goal 1

Goal 1: Implement 75 conservation practices that reduce storm water runoff (rain barrels, rain gardens, bioswales) in conjunction with increased educational awareness activities.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/Match Sources**
Promote best management practices	Install urban best management practices that reduce storm water runoff	Urban/suburban landowners	Watershed Project staff and SWCD staff	Phase I: 2011-2014	Number of BMPs installed.	15,000 dollars funding for rain barrels, rain garden/bioswale, porous pavement 5,000 dollars match for rain barrels, rain garden/bioswale, porous pavement	319 grant and SWCD Match from landowner cost share portion

Table 5.4.6-2 Problem 5, Goal 2

Goal 2: Increase awareness of storm water runoff issues with use of education events. Provide 100 education hours on events that focus on storm water runoff and how to alleviate the issue.							
Objective	**Action Item**	**Target Audience**	**Responsible party**	**Schedule**	**Indicators**	**Funding/Match Estimates**	**Potential Funding/Match Sources**
Increase education of storm water runoff issues	Host field day/workshop highlighting a practice that promotes water infiltration	All residents in watershed and surrounding areas	Watershed Project staff and SWCD staff, MS4 staff	Phase I: 2011-2014	Number of education hours, post-survey awareness results, local drainage board participation, awareness of storm water issues.	100 dollars 150 dollars match	319 grant and SWCD Match from private sponsors and speakers time
	Increase number of storm drains marked	All residents in watershed and surrounding areas	Watershed project staff, steering committee, SWCD staff and MS4 staff	Phase I: 2011-2020		200 dollars 300 dollars match	319 grant Match from SWCD staff and local MS4 staff
	Distribute materials concerning storm water runoff	All residents in watershed and surrounding areas, contractors	Watershed Project staff and steering committee and SWCD staff	Current, to be completed by 2014		150 dollars	319 grant and SWCD
	Participate when possible with local drainage boards	County drainage boards, steering committee	Watershed Project staff and steering committee	Current, ongoing through 2014		150 dollars for 319 staff time. 100 dollars match time	319 grant Match from SWCD and steering committee time

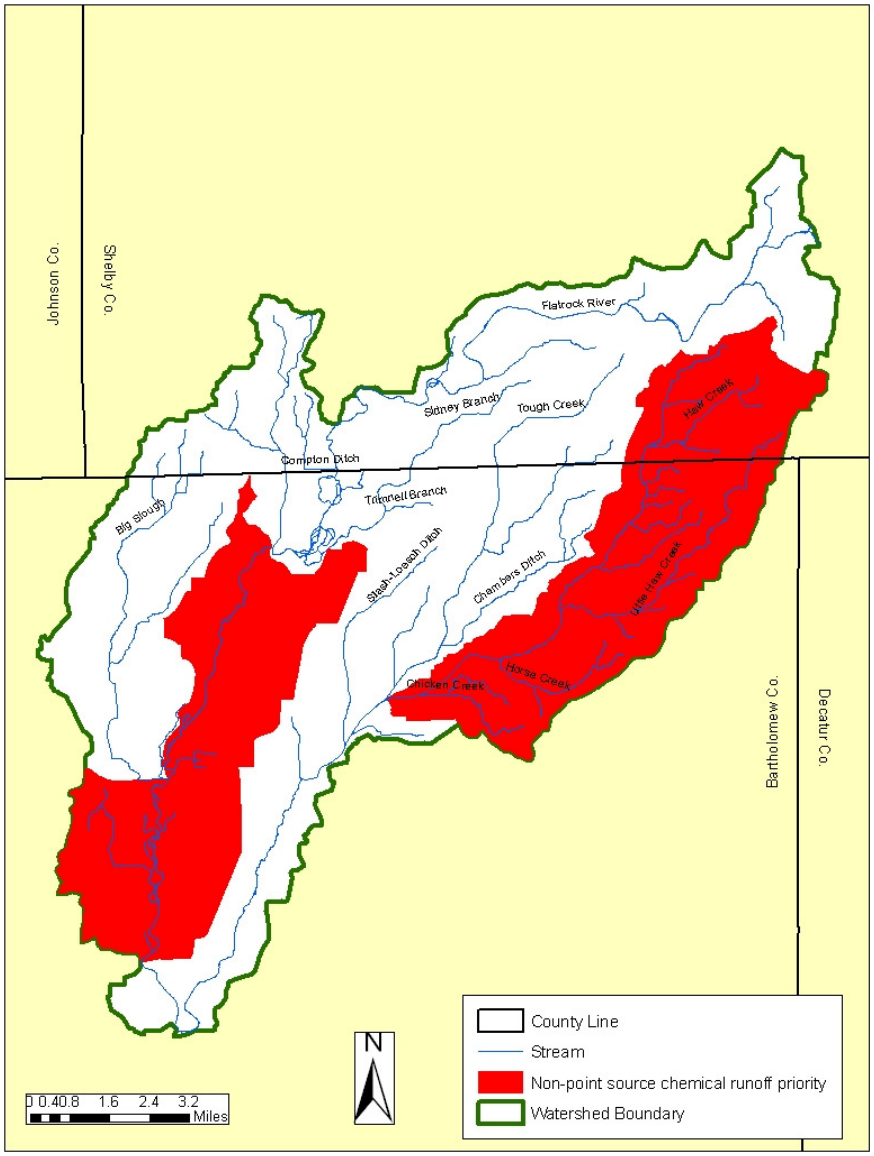
6.0 Identifying Critical Areas for Runoff

It is known that E.coli is a problem throughout the watershed and sediment as well as phosphorus is a problem based on the L-THIA estimates and the TMDL. Nitrogen was not identified as a problem based on the L-THIA estimates but is a problem at times based on our water monitoring data. The local steering committee has decided that while concerns occur watershed-wide the area of the watershed is broad so they used a variety of information to select specific areas to focus on. The steering committee has used windshield surveys, information gathered from a technical and a public meeting, local knowledge, the L-THIA estimates, and past/current water quality data to identify areas of the watershed where efforts would show the most benefit in improving water quality. Utilizing 14 digit HUC boundaries, the committee prioritized areas for non-point source nutrient runoff, biological contamination (E. coli), and sediment loading. The committee decided to use 14 digit HUC boundaries so the critical areas could be narrowed to smaller areas, so as to focus on the specific sources identified. Although other problems were identified the three prioritized groups were determined to be the largest contributing contaminants and the areas the steering committee would like to focus their efforts on. No critical areas were noted for the lack of recreation due to poor water quality and the rate of water leaving the watershed goals because they will somewhat be addressed through practices that also reduce the nutrient, biological and sediment contaminants. The Steering Committee feels once water quality is improved in critical areas, recreation will also increase. Additionally, increased awareness and education efforts (watershed wide) will help meet these goals.

6.1 Non-point Source Nutrient Runoff

Sub watersheds prioritized for non-point source nutrient runoff include all of Haw Creek and a major portion of Town of Northcliff-Flatrock River (Figure 6.1). These two prioritized areas drain approximately 30,898 acres (37%) of the watershed. These areas encompass the headwaters of Haw Creek, including initial tributaries before Tough Creek flows into it and the lower portion of Flatrock River. The Haw Creek sub watershed is noted for nitrate contamination to the wells and having areas where a high nitrate leaching potential. While nitrate leaching can affect ground water it also affects surface waters as excess nitrate in the soil can leach to streams before it is able to infiltrate into groundwater. Also, some streams are fed by groundwater. Town of Northcliff-Flatrock River has areas of sandy soils and irrigation systems, where leaching potential for nutrient runoff is increased. The past water quality data sites in these target areas include the 800 N and the SR 11 IDEM sites (Table 4.4.1-2). The SR 11 site has had one occurrence where total phosphorus was above the IDEM target level. There is also a current water monitoring site in the Haw Creek sub watershed. It has shown one value above the standard for both nitrate-N and ammonia-N and three values above the target level for total phosphorus. Based on the LTHIA results both of these watersheds have total phosphorus concentrations above the target level.

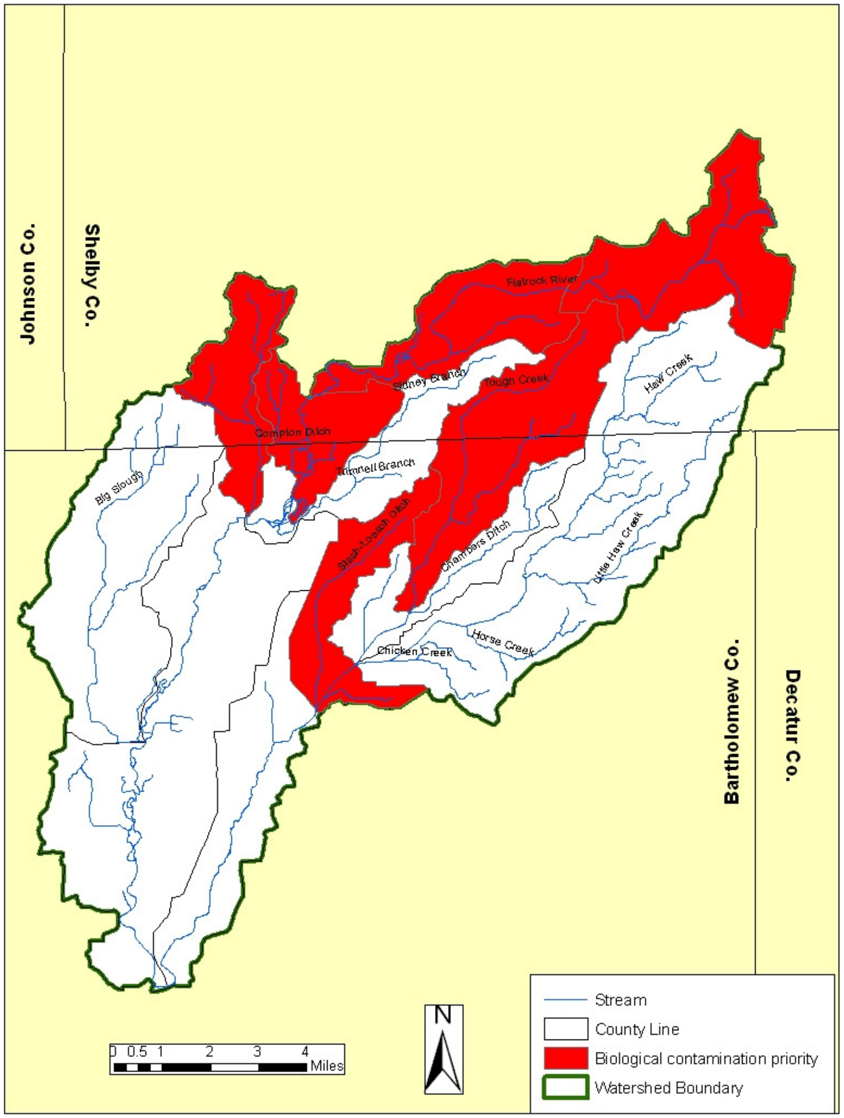
Figure 6.1 Sub watersheds prioritized for NPS nutrient runoff



6.2 Biological Contamination

Sub watersheds prioritized for biological contamination are the Town of Geneva-Flatrock River, the western half of Sidney Branch-Flatrock River, and the upper portion of Little Haw Creek-Haw Creek. Collectively, the areas prioritized drain approximately 39,310.5 acres (47%). Town of Geneva-Flatrock River has exceeded the standard for E.coli five times in the past twenty months for the project (Table 4.4.1-6). Historical data has shown one value above 2400 cfu/100 mL (Table 4.4.1-2). The project's site at Ensley's Ditch has shown E.coli standards being exceeded eleven times of the twenty months samples were taken (Table 4.4.1-6). Historic data from 1997 also shows two samples where the standard was exceeded (Table 4.4.1-2). In Little Haw Creek-Haw Creek there is one monitoring site just outside of the target area which has had E.coli values that exceed the standard eight of the twenty months (Table 4.4.1-6). LTHIA loads were not calculated for biological contamination.

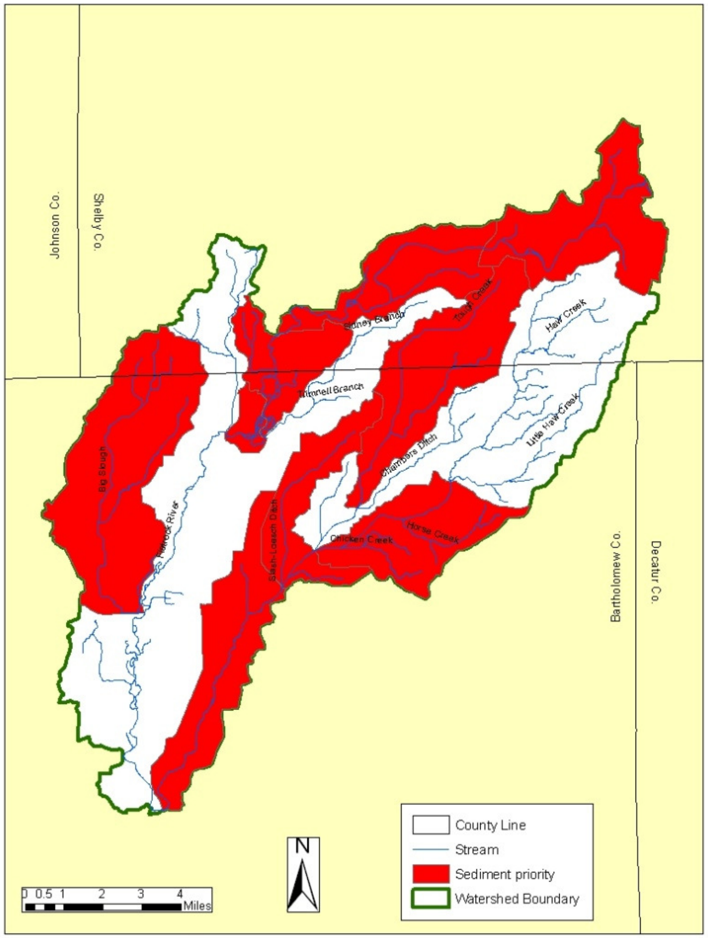
Figure 6.2 Sub watersheds prioritized for biological contamination



6.3 Sediment contamination

Sub watersheds prioritized for sediment include Town of Geneva-Flatrock River, the eastern half of Sidney Branch-Flatrock River, Big Slough, the lower half of Haw Creek, and a majority of Little Haw Creek-Haw Creek. Collectively, the areas prioritized for sediment include 46,515.5 acres (55%) of the watershed. There are many areas that are prioritized for sediment that are also prioritized for either non-point source nutrient runoff or biological contamination due to multiple source concerns identified. Conventional tillage is still used in the bottomland areas in Town of Geneva-Flatrock River, Sidney Branch and Little Haw Creek-Haw Creek. Excessive stream bank erosion was mentioned at both the technical and public meetings upstream of the Hope lift station in Haw Creek. Big Slough has both new construction areas and bare soil exposure from tree removal. Historic data at the SR 252, near Flatrock has had seventeen samples over the standard target for suspended sediment (Table 4.4.1-2). Also, the past Hoosier Riverwatch site shows one sample over the target level of 10.4 NTU's (Table 4.4.1-5). Five of our six current water monitoring sites are located in these target areas. All of the sites have at least one sample over the NTU target limit and most of them have several (Table 4.4.1-6). In addition the L-THIA estimates for all sub watersheds showed estimates above the target limit for suspended sediment.

Figure 6.3 Sub watersheds prioritized for sediment



7.0 Implementing the Plan, Long-term Results, and Evaluation

During the process of management planning, the Steering Committee recognized that to help meet their goals and action items additional financial assistance was needed (Section 5.4). For this reason the Committee worked with the SWCD Board through the Watershed Project staff to apply for a Section 319 Non point Source grant from the Indiana Department of Environmental Management for further work through implementation.

Included in the grant application is money for the installation of agricultural and urban/suburban Best Management Practices (BMPs), public outreach/educational programming, and water monitoring. This includes funds for personnel and administrative costs.

In order to deliver the BMPs throughout the watershed, the Committee will finalize a cost share program, designed to assist residents of the watershed with the costs of implementation. Projects will be ranked according to objective criteria, designed to maximize dollars spent for improvement of water quality in the Flatrock-Haw Creek Watershed. Practices identified in Table 7.0 identifies a list of practices that the steering committee has determined as beneficial to the watershed as well as the estimated load reductions attributed to each practice. The steering committee feels that a wide variety of conservation practices need to be available to reach all audiences in the watershed.

If the grant is awarded, applications for involvement in the cost share program will be available through the Bartholomew and Shelby County SWCDs. Also, the Steering Committee will continue to meet on a regular basis for the purpose of assisting with implementation efforts. Finally, the existing volunteer water quality monitoring network will continue to collect water quality data. This will help to monitor the effectiveness of conservation practices throughout the watershed.

To achieve the goals for contaminant reduction set by the steering committee the approximate amount of practices that will need to be installed include 8,000 acres of nutrient management planning; 3,000 acres of cover crops; 15 heavy use area protection; 400 acres of pasture re-seeding; 6,000 acres of conversion to no-till; 4 acres of conservation cover; and porous pavement on areas that have a total of 4 acres of drainage. Additional practices including drainage control structures, heavy use area protection, prescribed grazing, and other pasture practices help to reduce contaminants, though the load reductions for each practice is harder to quantify. If these practices are installed it would exceed the phosphorus 15 year reduction goal and come close to meeting the nitrogen 15 year reduction goal. While it would only meet approximately 40% of the 25 year sediment reduction goal additional practices supported by NRCS such as grassed waterways (which help with gully erosion), filter strips and quail buffers would greatly add to nutrient and sediment reduction.

Due to adaptive management, as the project progresses goals and objectives will need to be reassessed and/or revised annually. This revision will be completed by the steering committee, 319 grant staff and SWCD staff. Overall project progress will be tracked by measurable items such as attendance at events and acres of conservation implemented. Ultimately, long term goals for the project involve contaminant load reduction for the improvement of water quality. Using the Region 5 Estimation model load reductions have been estimated for many BMPs (Table 7.0). Water monitoring will follow the existing Quality Assurance Project Plan (QAPP). The QAPP will be revised by 319 grant staff to incorporate new analysis methods as needed. Surveys after each education event as well as pre/post cost share surveys will help determine awareness change as well as provide additional information to the staff regarding how to better reach each audience.

Table 7.0 Best Management Practices and estimated load reduction

BMP	Nitrogen	Phosphorus	Sediment
Cover Crop	0.64 lb/acre	0.30 lb/acre	0.25 tons/acre
Conservation Cover	6 lb/acre	3 lb/acre	3 tons /acre
Pasture & Hay Seeding	5.32 lb/acre	2.67 lbs/acre	1.96 tons/acre
Nutrient Management Plan	11 lb/acre	48 lb/acre	N/A
Comprehensive Nutrient Management Plan	Depends	Depends	N/A
Alternative Watering	N/A	N/A	N/A
Stream Crossing	0.6 lbs/unit	0.6 lbs/unit	0.6 tons/unit
Fencing	0.04 lbs/ft.	0.02 lbs/ft.	0.15 tons/foot
Pipeline	N/A	N/A	N/A
Heavy Use Area Protection	0.0002 lb/pad	0.0001 lb/pad	0.8 tons/pad
Water well development	N/A	N/A	N/A
Prescribed grazing	0.37 lbs/ac	0.2 lbs/ac	0.14 tons/ac.
Waste Utilization	Depends	Depends	N/A
Residue Management (No-till)	1.75 lbs/acre	2 lbs/acre	0.002 tons/acre
Control Structures	15%-75% of load	N/A	N/A
Riparian forest buffer	Depends	Depends	Depends
Rain gardens	1 lb/acre drained	1 lb/acre drained	0.05 tons/acre drained
Bio swales	0.45 lbs./acres drained	0.16 lbs/acres drained	0.08 tons/acres drained
Rain barrel	N/A	N/A	N/A
Tree & Shrub Establishment	Depends	Depends	Depends
Porous Pavement	6 lbs/acre drained	1 lb/ acre drained	0.15 tons/acre drained
Streambank Stabilization	68 lbs/year	34 lbs/year	34 tons/year
Grade Stabilization	28.6 lbs/year	14.3 lbs/year	14.3 tons/year
Two-stage Ditches	68 lbs/year	34 lbs/year	34 tons/year

8.0 References

Bartholomew County Historical Society, 1976 Annotated edition. History of Bartholomew County 1888. Volume I. 19th century.

Conservation Technology of Information Center (CTIC). 2002. Tillage Type Definitions. http://www2.ctic.purdue.edu/Core4/CT/Definitions.html

Gray, H.H, 2000. Physiographic divisions of Indiana. Indiana Geol. Survey Spec. Rep. 61. Indiana Univ., Bloomington.

Maier, Randal D, 2004 Bedrock Aquifer Systems of Bartholomew County, Indiana. IDNR, Division of Water, Resource Assessment Section.

Meadows, W.C. and C.E. Bair, 2000. An Archeological survey of high probability water course development areas in the east fork white river watershed in south central Indiana. Glenn A. Black Laboratory of Archeology. Indiana University. Report of Investigations 00-07.

NCDC-NOAA, 2008. http://cdo.ncdc.noaa.gov/climatenormals/clim81/INnorm.pdf

STATS Indiana, 2000. 2000 Census data. http://www.stats.indiana.edu/

The Encyclopedia of IN. 2nd edition. 1993. Somerset publishers.

Water Quality Targets. http://www.in.gov/idem/6242.htm

Hill, J.R. Indiana Geologic Survey. 2009. http://igs.indiana.edu/geology/topo/landscapes/index.cfm

Appendix A: Project Involvement

Steering Committee Members (Past & Present)

Name	Affiliation	Past/Present Member
David Clouse	Hope City Utilities	Past
Gary Dodd	Landowner/Farmer	Past
Robert Finkel	Landowner/Farmer	Present
Justin Gelfius	Landowner/Farmer	Past
Jim Kelly	Landowner	Present
Janice Kroger	Landowner	Past
Emilie Pannell	City of Columbus-Planning	Past
Ronald Povinelli	Landowner	Present
Fred Prazeau	Landowner	Present
Colin Scheidt	Landowner	Present
Ed Stone	Clifford Town Board/Fire Department	Present
Elizabeth Trybula	Landowner	Past

Organizations involved in Project Development

Bartholomew County Soil & Water Conservation District
1040 Second Street, Columbus, IN 47201
(812) 378-1280 ext. 3
http://bartholomewswcd.org/

Shelby County Soil & Water Conservation District
2779 South 840 West, Manilla, IN 46150
(765) 544-2051 ext. 7
http://www.shelbycountyswcd.org/

Natural Resource Conservation Service
6013 Lakeside Boulevard, Indianapolis, IN 46278
(317) 290-3200
www.in.nrcs.usda.gov
Indiana Department of Environmental Management
Office of Water Quality, 100 North Senate Avenue, Indianapolis, IN 46204
(317) 233-2481
www.in.gov/idem/

United States Geologic Survey
5957 Lakeside Boulevard, Indianapolis, IN 46278
(317) 290-3333
http://in.water.usgs.gov/

Kidscommons Children's Museum of Columbus
309 Washington Street, Columbus, IN 47201
(812) 378-3046
www.kidscommons.org

Hoosier Riverwatch
Fort Harrison State Park-NREC
5785 Glenn Road, Indianapolis, IN 46126
(317) 541-0617
www.hoosierriverwatch.com

Bartholomew County Solid Waste Management District
720 South Mapleton Street, Columbus, IN 47201
(812) 376-2614
www.bcswmd.com

Bartholomew County Health Department
440 Third Street, Suite 303, Columbus, IN 47201
(812) 379-1550
www.bartholomewco.com/health

Bartholomew County Commissioners
440 Third Street, Columbus, IN 47201
(812) 379-1515
www.bartholomewco.com/commissioner

City of Columbus
123 Washington Street, Columbus, IN 47201
(812) 376-2570
www.columbus.in.gov

Appendix B: Watershed Survey

Bartholomew County Soil & Water Conservation District

Please take a few minutes to complete this short survey (both sides).

All returned surveys will be entered into a drawing for one of two Papa Deli's gift certificate, graciously donated by the Papa's Third Street Deli.

1.) Do you know what a watershed is?
   a. Absolutely, no doubt in my mind.
   b. I have a general idea.
   c. I have heard of a watershed, but couldn't tell you what it is.
   d. I have no idea

2.) Please briefly (in 1-3 sentences) describe your definition of a watershed.

3.) Please list any local rivers and/or streams you are familiar with.

4.) Please circle any and all items listed below that are potential sources of nonpoint pollution in rivers/streams:
   a. Residential lawn
   b. Agricultural field
   c. Industrial discharge
   d. Sewage treatment plant
   e. Roads/driveway/parking lot
   f. Golf course

5.) In general, do you think water quality in your area is improving, or do you think water quality is getting worse?
   a. Improving
   b. Getting worse.

6.) Are you familiar with Haw Creek?
   a. Yes
   b. No

7.) What do you think of the water quality in Haw Creek?
   a. The creek is clean.
   b. The creek could be better, but overall is clean.
   c. The creek is not clean, but is not terrible.
   d. The creek is not clean.
   e. I have no opinion on the subject.

8.) How important do you think overall water quality is for you and/or your family?
   a. Very important

b. Somewhat important
c. Not very important
d. Not at all important

9.) On a scale of 1 to 10, with 1 being your lowest priority and 10 being your highest priority, where do you place water quality when making personal decisions?

1 2 3 4 5 6 7 8 9 10
lowest highest

10.) On a scale of 1 to 10, with 1 being your lowest priority and 10 being your highest priority, where do you think water quality should be placed when making community decisions?

1 2 3 4 5 6 7 8 9 10
lowest highest

Please include any additional comments regarding the subject of water quality in your county here:

NAME: ____

PHONE NUMBER (optional) ____

Appendix C: Concern card

Please rank these concerns based on your knowledge of the watershed. A ranking of one is what you feel to be the highest priority and 5 is the lowest priority.

____ Lack of education pertaining to water quality issues

____ Erosion (Sedimentation)

____ Biological contamination (E. coli)

____ Chemical contamination (Nitrates, Phosphates)

____ Trash/debris along stream banks

____ Other

____
____

Please list below any areas you can specifically think there may be a problem. This can include excessive erosion along a stream, excess trash and debris along a stream bank, sensitive areas that may need protected (State parks, preserves, etc.), or any other areas where you have seen a large problem.

____
____
____
____
____
____

Appendix D: Water Quality Data (2009-2011)

Date	Site #	D.O. Avg.	E.coli per 100 mL	pH avg (units)	Nitrate (mg/L)	Ammonia (mg/L)	T.Phos (mg/L)	BOD 5-day(mg/L)	Flow/Discharge (cfs)
5/3/2009	FLAT01	11.00		8.16	7.37	0.1	0.38	3.76	
5/3/2009	ENS02	8.33		8.31	7.02	0.03	0.05	-0.71	9.44
5/3/2009	BIG03								
5/3/2009	HAW04								
5/3/2009	HAW05N	9.67		8.12	7.61	0.03	0.11	0.34	190.65
5/3/2009	HAW05S	8.00		8.06	7.06	0.03	0.1	-0.85	
6/7/2009	FLAT01	12.00	0	8.51	6.87	0.04	0.04	2.78	397.3
6/7/2009	ENS02	9.67	600	8.31	7.92	0.02	0.1	-0.19	2.49
6/7/2009	BIG03								
6/7/2009	HAW04	8.50	200	8.39	7.53	0.04	0.07	-1.56	
6/7/2009	HAW05N	6.33	700	7.82	6.85	0.04	0.05	-0.85	33.75
6/7/2009	HAW05S	7.33	6500	8.1	5.21	0.02	0.05	-1.24	50.37
7/12/2009	FLAT01	10.83	600	8.3	4.26	0.05	0.07	3.14	384.89
7/12/2009	ENS02	6.00		8.28	5.7	0.04	0.14	-2.65	39.92
7/12/2009	BIG03								
7/12/2009	HAW04	9.00	1900	8.07	4.76	0.04	0.22	0.22	
7/12/2009	HAW05N	9.00	10000	8.06	4.7	0.06	0.23	1.35	54.57
7/12/2009	HAW05S	5.33	1400	8	3.75	0.05	0.12	-2.71	71.34
7/26/2009	BIG03	8.00		7.96	6.84	<0.02	0.05	0.09	8.51
8/2/2009	FLAT01	9.43	100	8.4	7.47	0.04	0.14	1.92	667.24
8/2/2009	ENS02	10.67	600	8.52	9	0.2	0.02	0.39	2.22
8/2/2009	BIG03								
8/2/2009	HAW04	7.67	200	7.94	6.69	0.03	0.11	0.2	23.84
8/2/2009	HAW05N	6.00	400	7.95	6.67	0.04	0.07	-0.77	41.63
8/2/2009	HAW05S	5.50	666	7.8	4.95	0.03	0.07	-2.4	72.88
9/10/2009	HAW04	4.83	0	7.76	0.17	0.17	0.49	4.75	3.2
9/13/2009	FLAT01	12.00	0	8.5	1.76	0.08	0.04	0.89	196.13
9/13/2009	FLAT01	7.00		6.4					
9/13/2009	ENS02	12.00	0	8.38	0.02	0.02	0.01	0.4	1.38
9/13/2009	ENS02	7.00		6.94					
9/13/2009	BIG03								

Date	Site #	D.O. Avg.	E.coli per 100 mL	pH avg (units)	Nitrate (mg/L)	Ammonia (mg/L)	T.Phos (mg/L)	BOD 5-day(mg/L)	Flow/Discharge (cfs)
9/13/2009	BIG03								
9/13/2009	HAW04	7.50		6.86					
9/13/2009	HAW05N	6.33	1050	7.69	0.02	0.02	0.13	1.74	20.22
9/13/2009	HAW05N	7.50		6.86					
9/13/2009	HAW05S	6.67	200	7.7	0.02	0.02	0.06	0.99	42.42
9/13/2009	HAW05S	8.00		6.2					
10/4/2009	FLAT01	10.00	1650	8.29	4.86	0.05	0.17	1.33	
10/4/2009	ENS02	9.00	1100	8.26	8.01	0.04	0.16	0.26	2.77
10/4/2009	BIG03								
10/4/2009	HAW04	7.50	400	8.19	3.06	0.03	0.06	0.71	
10/4/2009	HAW05N	7.33	2650	7.88	4.65	0.03	0.11	0.6	43.37
10/4/2009	HAW05S	6.67	3450	7.8	5	0.03	0.1	0.52	54.26
10/12/2009	BIG03				7.14	<0.02	0.06	<3	267.15
11/1/2009	FLAT01	8.67	1700	8.15	7	0.03	0.5	3.33	
11/1/2009	ENS02	12.00	800	8	7.16	0.02	0.1	0.69	140.31
11/1/2009	BIG03								
11/1/2009	HAW04	7.00	400	7.92	5.66	0.02	0.24	1.35	84.55
11/1/2009	HAW05N	9.33	1100	7.78	5.78	0.02	0.32	1.52	196.63
11/1/2009	HAW05S	5.00	1000	7.75	5.24	0.01	0.3	1.66	
12/6/2009	FLAT01	12.00	0	8.59	5.06	0.03	0.04	1.94	263.22
12/6/2009	ENS02	12.00	200	8.37	6.16	0.02	0.03	1.73	4.1
12/6/2009	BIG03								
12/6/2009	HAW04	11.00	0	8.4	4.96	0.02	0.06	1.96	294.59
12/6/2009	HAW05N	10.67	0	8.63	5.26	0.02	0.05	2.14	65.69
12/6/2009	HAW05S	5.00	0	8	3.94	0.02	0.06	1.32	74.1
1/10/2010	FLAT01	12.00	0	8.42	4.19	0.03	0.04	1.85	
1/10/2010	ENS02	12.00	0	8.59	5.74	0.03	0.04	1.15	3.1
1/10/2010	BIG03								
1/10/2010	HAW04	10.17	0	8.6	6.83	0.03	0.04	1.67	
1/10/2010	HAW05N	12.00	0	8.89	4.62	0.02	0.05	1.33	24.89
1/10/2010	HAW05S	10.00	0	7.8	2.8	0.02	0.06	1.5	53.25

Date	Site #	D.O. Avg.	E.coli per 100 mL	pH avg (units)	Nitrate (mg/L)	Ammonia (mg/L)	T.Phos (mg/L)	BOD 5-day(mg/L)	Flow/Discharge (cfs)
2/7/2010	FLAT01	12.00	0	8.25	5.4	0.05	0.04	1.44	
2/7/2010	ENS02	11.67	0	8.35	7.4	0.04	0.04	1.21	5.43
2/7/2010	BIG03								
2/7/2010	HAW04	10.20	0	8.19	5.35	0.06	0.06	1.48	
2/7/2010	HAW05N	11.67	0	8.65	5.74	0.04	0.05	0.81	27.37
2/7/2010	HAW05S			7.28					31.35
3/6/2010	FLAT01	10.00	0	8.37	0.1	0.03	0.1	0.48	
3/6/2010	ENS02	12.00	0	8.3	0.03	0.03	0.03	0.55	6.13
3/6/2010	BIG03								
3/6/2010	HAW04	12.00	0	8.77	6.83	0.11	0.12	1.76	69.62
3/6/2010	HAW05N	10.67	0	8.45	6.36	0.06	0.1	2.14	82.34
3/6/2010	HAW05S	9.33	0	8.07	5.52	0.04	0.08	1.7	
3/11/2010	BIG03				9.26	0.07	0.06	<1	2.32
4/11/2010	FLAT01	10.00	0	8.24	7.57	0.06	0.2	0.44	
4/11/2010	ENS02	9.00	200	8.05	8.67	0.07	0.06	0.67	7.87
4/11/2010	BIG03				7.91	0.09	0.09	<1	
4/11/2010	HAW04	8.00	300	8.17	7.25	0.08	0.09	0.16	52.56
4/11/2010	HAW05N								
4/11/2010	HAW05S	11.00	600	7.9	5.6	0.06	0.1	0.39	74.59
5/2/2010	FLAT01	6.67	5450	8	4.91	0.14	0.96	3.24	
5/2/2010	ENS02	5.50	14500	7.61	4.3	0.15	1.45	3.92	895.49
5/2/2010	BIG03								
5/2/2010	HAW04	7.00	8900	7.72	6.71	0.32	1.42	4.78	
5/2/2010	HAW05N								
5/2/2010	HAW05S								
5/17/2010	BIG03				10.5	0.06	0.05	2	
6/6/2010	FLAT01								
6/6/2010	ENS02	7.33	1050	8.2	9.68	<0.02	0.02	0.55	4.89
6/6/2010	BIG03								
6/6/2010	HAW04	8.00		8.43	10.5	0.05	0.32	0.68	29.91
6/6/2010	HAW05N								
6/6/2010	HAW05S								

Date	Site #	D.O. Avg.	E.coli per 100 mL	pH avg (units)	Nitrate (mg/L)	Ammonia (mg/L)	T.Phos (mg/L)	BOD 5-day(mg/L)	Flow/Discharge (cfs)
6/8/2010	BIG03				7.77	0.03	0.06	2	
7/11/2010	FLAT01	12.00	250	8.42	6.44	0.02	0.01	1.19	522.19
7/11/2010	ENS02	10.00	250	8.35	9.72	0.02	0.02	1.05	3.78
7/12/2010	BIG03				4.59	0.04	0.09	<1	
7/11/2010	HAW04	10.00	500	8.57	5.29	0.02	0.3	3.85	14.75
7/11/2010	HAW05N								
7/11/2010	HAW05S								
8/1/2010	FLAT01	11.00	0	8.4	5.25	0.05	0.11	0.5	205.4
8/1/2010	ENS02	9.67	2900	8.24	10.4	0.03	0.02	0.51	1.59
8/1/2010	BIG03								
8/1/2010	HAW04	11.00	100	8.16	1.79	0.05	0.16	0.78	3.42
8/1/2010	HAW05N								
8/1/2010	HAW05S								
9/12/2010	FLAT01	7.00	0	8.05	1.9	0.06	0.08	1.54	105.16
9/12/2010	FLAT01	6.33		6.62					
9/12/2010	ENS02	11.33	450	8.42	9.85	0.03	0.02	-0.19	0.33
9/12/2010	BIG03								
9/12/2010	HAW04	7.00	100	7.88	0.6	0.03	0.08	0.63	0
9/12/2010	HAW04	8.00		6.43					
9/12/2010	HAW05N								
9/12/2010	HAW05S								
10/3/2010	FLAT01	10.33	200	8.23	1.19	0.05	0.03	1.14	
10/3/2010	ENS02	10.33	200	8.21	8.3	0.03	0	0.81	0.85
10/3/2010	BIG03								
10/3/2010	HAW04	7.00	2650	8.16	0.38	0.02	0.31	0.97	
10/3/2010	HAW05N	9.00	Not Countable	8.04	2.89	0.03	0.05	0.78	2.53
10/3/2010	HAW05S								
11/7/2010	FLAT01	12.00	0	8.36	2.06	0.05	0.04	1.39	1328.46
11/7/2010	ENS02	12.00	1350	8.32	12.6	0.03	0.02	1.18	6.8
11/7/2010	BIG03								
11/7/2010	HAW04	8.00	2450	8.16	0.86	0.03	0.08	1.34	
11/7/2010	HAW05N	12.00	450	8.2	5.45	0.03	0.03	1.23	

Date	Site #	D.O. Avg.	E.coli per 100 mL	pH avg (units)	Nitrate (mg/L)	Ammonia (mg/L)	T.Phos (mg/L)	BOD 5-day(mg/L)	Flow/Discharge (cfs)
11/7/2010	HAW05S								
12/5/2010	FLAT01								
12/5/2010	ENS02	10.33	300	8.27	8.1	0.05	0.04	0.77	27.22
12/5/2010	BIG03								
12/5/2010	HAW04	9.00		8.5	7.62	0.05	0.2	3.2	73.96
12/5/2010	HAW05N	4.67	650	8	6.96	0.04	0.16	1.83	179.22
12/5/2010	HAW05S								
1/9/2011	FLAT01	12.00	0	8.6	8.06	0.04	0.05	2.22	
1/9/2011	ENS02	9.50	150	7.6	9.1	0.04	0.02	1.45	1.29
1/9/2011	BIG03								
1/9/2011	HAW04	12.00	200	8.45	8.58	0.05	0.36	2.14	
1/9/2011	HAW05N								
1/9/2011	HAW05S								
2/6/2011	FLAT01								
2/6/2011	ENS02		750	8.55	8.63	0.04	0.04	1.37	2.38
2/6/2011	BIG03								
2/6/2011	HAW04		950	8.29	8.82	0.03	0.06	1.8	31.8
2/6/2011	HAW05N								
2/6/2011	HAW05S								
3/6/2011	FLAT01	12.00	800	7.88	3.76	0.26	1.17	3.36	
3/6/2011	ENS02	5.00	500	7.95	8.86	0.26	0.45	0.69	330.58
3/6/2011	BIG03								
3/6/2011	HAW04	7.00	800	7.62	6.23	0.51	0.28	1.68	
3/6/2011	HAW05N								
3/6/2011	HAW05S								
3/14/2011	BIG03				8.8	0.02	0.03	1	
4/5/2011	FLAT01	1.91	300	8.60	6.09	0.03	0.02	1.91	
4/5/2011	ENS02	1.1	0	8.32	8.56	0.02	0.01	1.1	3.25
4/5/2011	HAW04	2.67	0	8.81	6.90	0.30	0.06	2.67	22.54
4/5/2011	HAW05N	1.96	100	7.05	6.45	0.12	0.15	1.96	
4/5/2011	HAW05S								